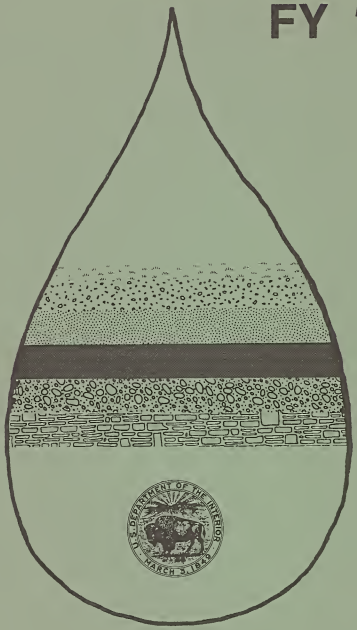
WORK PLAN

FY '80



U.S. GEOLOGICAL SURVEY

&

BUREAU OF LAND MANAGEMENT

21013800
ID 88015621

GB
658.7
.L362
1980

TABLE OF CONTENTS

Page

Preface i

Summary of Funds 1

Agreements
Water Resources Division 4
Alabama 7
Colorado 16
Idaho 29
Montana 32
Nevada 48
New Mexico 50
North Dakota 59
Oklahoma 70
Utah 80
Wyoming 88
Central Region 98
Office of Public Land Hydrology 99
Channel Geometry 103

Branch of Coal Resources 106

Branch of Regional Geochemistry 115

Bureau of Land Management
Library
Bldg. 50 Denver Federal Center
Denver, CO 80225

BUREAU OF LAND MANAGEMENT LIBRARY
Denver, Colorado
88018621

Preface

The Bureau of Land Management each year requires data collection and analysis and technical consulting services of its sister agency, the U.S. Geological Survey. For fiscal year 1980 services are requested of the GS's Water Resources Division and Geologic Division (Branch of Coal Resources and Office of Geochemistry and Geophysics).

The Work Plan includes both EMRIA and non-EMRIA work items. Non-EMRIA work items are identified by a separate appropriation code included in each work item description. Agency contacts for the 1980 BLM/GS contract are as follows:

Bureau of Land Management

Herb Runkle, Chief, Division of Special Studies (FTS 234-2374)

Bruce Van Haveren (Hydrologist), Contracting Officer's Authorized Representative (FTS 234-2374)

Mrs. Ogie Bojanic, Contracting Officer (FTS 234-2195)

U.S. Geological Survey

Water Resources Division
Hugh Hudson, Reg. Program Officer, Central Region (FTS 234-4118)
Lee Dutcher, Energy Program Coordinator, Central Region (FTS 234-4118)

Branch of Coal Resources
Ed Landis, Chief (FTS 234-3578)

Office of Geochemistry and Geophysics
Richard Ebens, Chief (FTS 234-3715)

WATER RESOURCES DIVISION

Summary of Funds

BLM Costs

WATER RESOURCES DIVISION

State	EMRIA DSC	EMRIA State	Salinity	Other	Total
Alabama	$ 320,500	$ 9,000	-	-	$ 329,500
Colorado	661,800	-	$82,370	$23,350	767,520
Idaho	-	-	-	18,140	18,140
Montana	706,600	-	-	30,000	736,600
Nevada	-	-	-	10,000	10,000
New Mexico	212,100	-	-	-	212,100
North Dakota	315,600	-	-	-	315,600
Oklahoma	372,300	-	-	-	372,300
Utah	114,500	114,500	-	182,230	411,230
Wyoming	373,700	-	-	10,000	383,700
Central Region					
OPLH	120,850	-	-	35,000	155,850
Channel Geometry	100,000	-	-	-	100,000
TOTALS	$3,297,950	$123,500	$82,370	$308,720	$3,812,540

Summary of Funds

BLM Costs

BRANCH OF COAL RESOURCES

Alabama	
Northern Alabama	$ 1,500
Montana	
Prairie Dog Creek	2,000
New Mexico	
Ojo Encino	2,000
North Dakota	
Rattlesnake Butte	2,000
Oklahoma	
Arkoma Basin	2,000
Eastern and Western Sections	
Coordination, Supervisory Guidance and Support	30,000
TOTAL	$39,500

Summary of Funds

BLM Costs

BRANCH OF REGIONAL GEOCHEMISTRY

Alabama	$ 5,500
Colorado	18,000
Montana North Dakota	57,000
Oklahoma	17,000
Utah	2,500
TOTAL	$100,000

ANNUAL WORK PLAN

USGS WATER RESOURCES DIVISION AND BLM
Fiscal Year 1980

AUTHORITY

The General Agreement between the Bureau of Land Management (BLM) and the Geological Survey (GS), dated August 15, 1974, is considered an integral part of the Work Plan.

PURPOSE

The purpose of this work order is to specify the nature and amount of assistance to be provided by the GS to BLM during FY 80.

SCOPE

This work order includes all services to be provided by the GS under the EMRIA program to BLM in fiscal year 1980 in the States of Alabama, Colorado, Montana, Nevada, New Mexico, North Dakota, Oklahoma, Utah, and Wyoming. Also included are non-EMRIA work items for the states of Colorado, Idaho, Montana, Utah, and Wyoming.

The GS will provide the services, including personnel, equipment, supplies, and facilities, to conduct water resources investigations in areas designated by the BLM. Services will include installation, operation, and maintenance of surface-water gages, ground-water wells, and climate stations, as well as water-quality collection and analysis. Detailed descriptions of all studies in the ten states are presented in "Annual Work Plan for the BLM (EMRIA)/GS Water Resources Investigations - FY 80," which is considered an integral part of this work order.

PROCEDURE

Fiscal year 1980 is the sixth year of this cooperative effort. Some work that began in earlier fiscal years will be continued in fiscal year 1980, while some projects may be dropped. New studies will begin in fiscal year 1980, some of which will carry into fiscal year 1981 and beyond. These decisions will be made in joint meetings among the GS District and State offices and the Denver Service Center. The annual work plan is developed by D-450 after negotiations with BLM field offices to determine needs and GS field offices to determine capabilities, recommended hydrologic procedures, and for coordination with other studies conducted by the GS in other programs. The development of budgets takes into account the program needs of both agencies and funds available to meet those needs. When mutual interests are strong, funds from both agencies are applied. Funds tabulated in the work order, however, represent only those from BLM.

Field investigative procedures will be standard GS water resources investigation techniques.

REPORTS

Reporting will generally be standard GS report procedures with some deviations that are detailed in the Annual Work Plan.

Semiannual progress reports will be prepared by each Water Resources Division district and routed through the Central Region to BLM. Due dates for these reports will be April 15, 1980, and September 1, 1980.

In addition, a separate report on the progress of the precipitation-runoff modeling efforts in all states, covering the status of the small watersheds calibration, will be prepared jointly by the Precipitation-Runoff Modeling Project (USGS) and the EMRIA staff (BLM) and submitted to D-450 by September 1, 1980.

FUNDING

BLM will reimburse GS for actual expenses incurred in providing the service covered in this work order, not to exceed $3,812,540, upon receipt of SF 1081. Details of cost items for each study in each state are presented in the Annual Work Plan.

Alabama

ALABAMA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA FUNDS
Hydrologic Surveillance of Potential Mining Areas	$153,800
Hydrologic Modeling	46,200
Surface & Subsurface Hydrologic Evaluation of Potential Strip Mine Areas in the Warrior Coal Field	120,500
Baseline Hydrologic Data Collection (State EMRIA Funds)	9,000
	$329,500

ALABAMA

I. Coal Hydrology Study in North-Central Alabama

A. Location: The Warrior Coal Field is the principal area of study. It includes parts of Walker, Fayette, Tuscaloosa, and Jefferson Counties, about 3,900 sq mi. Principal basins monitored are Yellow, Turkey, Bear, and Blue Creek basins in Tuscaloosa County.

B. Objective: Collect and interpret basic data on water resources to aid BLM in its responsibility for preparing EIS's and in its planning and managing coal reserves underlying Federally controlled mineral rights. The primary objective requires the accomplishment of three subordinate objectives that are:

1. Definition of the hydrology (baseline conditions) of selected basins.

2. Determination of the effect coal mining will have on the hydrology.

3. Assessment of reclamation practices.

The latter assessment, because of changing laws during the life of the project, will be made largely by reviewing the literature and evaluating data obtained by coal hydrology projects that have monitored areas reclaimed under old laws.

C. Procedures: Standard U.S. Geological Survey methods will be used to collect streamflow, water quality, sediment, ground water, and precipitation data.

1. Surface water and its quality

a. Continue scheduled data collection at the following project stations:

Marriott Creek at Black Bottom, near Blount Springs
Mathis Creek near Sumiton
Blackwater Creek near Manchester
Cheatham Creek near Carbon Hill
Lost Creek near Jasper
Black Branch near Oakman
Cane Creek near Parrish
Wolf Creek at Corona
Blue Water Creek near Berry

Unnamed tributary to Blue Water Creek near Oakman
Wolf Creek near Oakman
Rock Creek near Hopkins
Unnamed tributary to Walker County Shoal Creek near Tutwiler School
Tributary to unnamed tributary to Walker County Shoal Creek near Tutwiler School
Little Yellow Creek near Whitson
Blue Creek near Windham Springs
Blue Creek near Spencer Hill
Hannah Mill Creek near Burchfield
Cane Creek near Searles
Yellow Creek near Windham Springs
Tributary to Yellow Creek near Windham Springs
Yellow Creek above Northport
Tributary to Yellow Creek near Northport
Yellow Creek near Northport
Tributary to Yellow Creek above Watermelon Road near Tuscaloosa
Cypress Creek near Holt
Hurricane Creek near Cedar Cove
Hurricane Creek near Holt
Unnamed tributary to Cane Creek near Pea Ridge
Cane Creek near Berry
Ellis Creek near Cleveland
Unnamed tributary to Freeman Creek near New Lexington
Little Tyro Creek near Sandtown
Tyro Creek near New Lexington
Tributary to Bear Creek near Samantha
Dry Branch near Samantha
Bear Creek near Samantha
Johnson Branch near Utley
Cripple Creek near Samantha
Cripple Creek east of Samantha
Tributary to Turkey Creek near Samantha
Turkey Creek near Tuscaloosa
Barbee Creek near New Lexington
Barbee Creek near Samantha

b. Increase data collection scope by adding 8 new partial record stations in mined basins to obtain data pertaining to effect of mining on hydrology.

c. Reduce scheduled data collection at 4 partial record stations in Yellow, Turkey, and Bear Creek basins because of baseline data adequacy collected to date.

2. Sediment--Continue scheduled sediment data collection at automated and partial record stations.

3. Ground water and its quality

   a. Continue scheduled water level measurements and sample collection from all wells in observation network.

   b. Run aquifer tests to determine aquifer characteristics in all test wells in the observation well network.

   c. Add selected test well to the network that is being drilled by the Conservation Division, USGS, as part of their work to estimate coal reserves and by the Geological Survey of Alabama as part of the overburden analysis program.

4. Biology--Limit biologic sampling to riffle areas at 4 sites in principal basins monitored. Pending financing, this work is being continued at BLM's request.

5. General

   a. Continue scheduled precipitation data collection and expand existing network of 9 sites to 15 sites to better relate precipitation to streamflow and water level fluctuations and to aid in facilitating modeling (see item II).

   b. Continue to tabulate and interpret on a current basis all data collected as a part of this project and similarly related projects.

   c. Continue contracting annual aerial photography acquisition to define degree of mining and land use changes in principal basins monitored.

   d. Continue coordination with other agencies to avoid data collection duplication and to inform them of project objectives and activities.

D. Report Plans: All collected data is placed in computer storage on an ongoing basis and will be published in USGS annual basic data reports. A progress report on the study covering the period of time from its beginning through October 1979 will be delivered to the Denver Service Center EMRIA Staff by September 30, 1980. An interpretive report on the biology of the study streams will be delivered to the Denver Service Center EMRIA Staff by September 30, 1980. Where feasible, project findings will be incorporated into papers prepared for presentation to professional coal mining organizations.

E. Relationship to Other USGS Studies: This project benefits from and supplements data collection at about 40 streamflow and water-quality stations being monitored in the Warrior Coal Field for OSM. Similarly, 3 automated stations monitoring mined basins as a part of Coal Hydrology Project AL 75-034 provide information pertaining to effect of mining on hydrology. These stations, equipped with stage recorders, rain gages, sediment samplers, and temperature and specific conductance recorders, are:

Blue Creek near Oakman
Dorsey Creek below Arkadelphia
Trinity Creek near Carbon Hill

F. Distribution of Funds:

Salaries	$104,500
Travel	3,500
Aerial Photography	3,000
Data Processing	2,500
Laboratory Services	34,000
Equipment and Supplies	6,300
	$153,800

II. Hydrologic Modeling

A. Location: Yellow Creek and Bear Creek basins in northern Tuscaloosa County are the study sites.

B. Objectives:

1. Develop and verify rainfall-runoff models for simulating streamflow.

2. Derive techniques to estimate water quality changes and sediment yield resulting from strip mining in ungaged basins in north-central Alabama.

C. Procedures: Model development will be based on calibration of measurable climatic, hydrologic, and physical features to achieve acceptable synthetic streamflow. It will be useful in estimating soil-moisture storage relationships, infiltration, and surface runoff; it will improve hydrologic data transfer to ungaged sites in the Warrior Coal Field.

The two basins selected for modeling represent contrasting hydrologic settings within the Coal Field. Thus, a gaging station in each basin is instrumented for continuous monitoring of streamflow, temperature, specific conductance, precipitation, and daily suspended sediment. Those stations are supplemented by a meteorological station, 7 recording rain gages, and 11 eleven soil moisture monitoring sites.

Model calibration and testing during FY 80 will be based on 2 years of data.

D. Report Plans: Study data is being stored in USGS computer data files and is available to other agencies and organizations. Progress reports containing available data and modeling activities are planned, as well as a final report at the end of the project.

E. Relationship to Other USGS studies: This project benefits from and supplements other programs in the Alabama District. A current project (AL 75-034) consists of monitoring actively mined watersheds and climatic and hydrologic data in the Warrior Coal Field. These sites will provide test cases for demonstrating model application in estimating effects of strip mining on the hydrology of mined watersheds.

F. Distribution of Funds:

Salaries	$32,000
Travel	4,700
Data Processing	7,500
Equipment and Supplies	2,000
	$46,200 1/

1/ Does not include salary of 1 BLM, WAE, hydrologist-modeler who will be assigned to the project.

III. Hydrogeologic Evaluation of Tract Delineated Areas of Potential Strip Mining in the Warrior Coal Field, Alabama

A. Introduction: A tract delineation team headed by Orin Gilbert, U.S. Geological Survey, Conservation Division, will outline potential strip-mine areas in the Warrior Coal Field, Alabama. Four of the tracts identified by the tract delineation team will be selected for hydrologic evaluations.

Considerable data collected in cooperation with BLM are available from the work currently underway in Yellow, Turkey, and Blue Creek basins. Much of these data represent baseline conditions in two geologic horizons; that is, one geological horizon in which the cover for the coal seams consists of sand and gravel and clay, and the other environment in which the material consists of primarily weathered Pottsville. This information would be useful in predicting approximately baseline or premining conditions in the four areas designated by the tract delineation team. Data also collected during mining are available that would be helpful in assessing the effects on the hydrologic system in these tract areas.

The Bureau of Land Management is interested in having a report prepared on these four areas based on information available from past and present studies to describe the hydrologic system and to assess the changes that might be imposed on the system should mining take place.

B. Problem: The Bureau of Land Management will be required to prepare an EIS for mining of Federally owned coal in Alabama. The preparation of a report on the areas of potential development will give BLM a first cut on the type of report that can be developed with existing publications and data with a minimum amount of field work for verification.

C. Objective: To prepare a report describing the hydrologic system prior to mining with an assessment of the anticipated impact of mining on the hydrologic system.

D. Approach: The following steps will be followed:

1. Divide the tract delineated, if required, on the basis of drainage basins.
2. Review geologic setting for the basin or basins.
3. Plot available hydrologic data (streamflow, quality of water, and ground water).
4. Determine basin characteristics, such as:
   (a) Drainage areas.
   (b) Land use-mined, agricultural, etc.
   (c) Slope.
   (d) Precipitation.
   (e) Water use.

5. On the basis of the geologic setting, select data representing baseline conditions from Yellow or Blue Creek basin to generate the following:
   (a) Streamflow characteristics.
   (b) Chemical quality of water (ground and surface).
   (c) Ground-water conditions (availability, water levels, etc.)
6. Make one round of measurements of streamflow, ground-water levels, and water-quality sampling to determine reliability of values determined for item 5 above.
7. Predict the effects of strip mining on the hydrologic system for the various basins included in the tract delineations.
8. Summarize results in a report prepared using the STOP technique.

E. Timeframe: This project will be for the period October 1979 through September 1980. The project will be completed with the report for the final tract delineation in September 1980.

F. Manpower: The project will be supervised by James R. Avrett, Hydrologist in Charge of the Subdistrict Office at Tuscaloosa and Water-Quality Specialist, who will be responsible for the quality of water work. John G. Newton, Hydrologist, Marvin E. Davis, or W.J. Powell will be responsible for the geologic sections and ground water of the report; and Roy Bingham will be responsible for putting the report together and writing various sections of the report. Celso Puente, Project Chief of AL-041, will be utilized as a consultant, and technicians are available in the subdistrict office at Tuscaloosa for making one round of measurements in each of the basins studied.

G. Funding: A total of $120,500 is available for funding of the subject project. A breakdown of the funding that may change after the tracts have been identified is as follows:

Salaries	$ 61,000
Laboratory Services	21,800
Travel	1,000
Drilling, equipment & supplies	36,700
Total	$120,500

The money for test drilling may be utilized in the salary portion of the funding, particularly since the size and areas of the tract delineation are not known at the present time.

IV. Baseline Hydrologic Data Collection

A. Location: Tuscaloosa County, Alabama
B. Timeframe: Three months (July through September).
C. Cost: $9,000

Colorado

COLORADO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA	SALINITY PROJECT	SOIL, WATER, AND AIR
Hydrologic Modeling	$167,300	---	---
Ground-Water Studies			
Coal-Bearing Aquifers	150,000	---	---
Hydrology & Reclamation			
Potential of Coal Spoil Piles	125,000	---	---
Hydrologic Characterization			
North Park	60,500	---	---
Raton Mesa	89,000	---	---
Collum Gulch	70,000	---	---
Evaluation of Salinity			
Potential of Mancos Shale Lands	---	$17,120	---
Water-Quality Stations	---	65,250	---
Operation of BLM Stations in San Luis Valley (CO-050-4340-5225)	---	---	$23,350
TOTALS	$661,800	$82,370	$23,350

TOTAL: STATE OF COLORADO $767,520

COLORADO

I. Hydrologic Modeling

A. Objectives: To define hydrologic system of the basin, interrelation of surface-water flow, ground-water movement, precipitation, and climate. The availability and quality of surface and ground water will also be defined. This information will be related to present and future mining operations to assess effects of mining on basin hydrology, and it will provide data for the total mining assessment.

For FY 80 the hydrologic monitoring program will be continued. Data on surface-water quantity and quality and area climate will be collected. Initial hydrologic modeling efforts in 1979 concentrated on evaluating input data to the model and organizing data in the computer to be compatible with the model. Some analysis on several parameters is needed to define values for missing data; this will be ongoing. In addition, initial model runs will be made and are being made with as much data as possible. Therefore, all the study watersheds in the Yampa Valley (sites 1, 2, and 3) are being considered.

Watersheds with sufficient water-quality data (sites 1 and 2) were analyzed and compared. This analysis, soon ready for the review process, consisted of a theoretical geochemistry framework with statistical analyses of the actual collected data. An additional 26 water-quality stations in the Yampa Valley area were added to the data base to attempt some regionalization of the major constituents and this analysis is continuing.

B. Study Watersheds:

1. Foidel and Middle Creek: Discharge, water temperature, and specific conductance are continuously monitored at 3 surface-water gaging stations. Monthly water samples are collected at each station to be analyzed for major chemical constituents and samples are collected quarterly at each station and analyzed for trace metals. Monthly sediment samples are collected at the upper Foidel Creek and the Middle Creek stations, and sediment samples at the lower Foidel Creek station are collected by an automatic suspended-sediment sampler.

A climatological station operated on Middle Creek measures precipitation, air temperature, relative humidity, soil temperature, wind, and solar radiation. A second precipitation gage is operated on the rehabilitation study area, and a third precipitation gage is installed at the mouth of Foidel Creek. Snow course data are also being collected.

Distribution of Funds:

Salaries	$30,000
Travel	3,100
Operation and maintenance of gages (including data storage)	10,000
Laboratory Analyses	12,000
Data Processing and modeling	3,800
	$58,900

2. Taylor, Wilson, Jubb Creek Basin: Discharge, water temperature, and specific conductance are continuously monitored at Wilson, Taylor and Jubb Creeks, and operation will continue. Monthly water samples are collected at each station and analyzed for major constituents and trace metals. Monthly sediment samples are collected at the Taylor and Jubb Creek stations and an automatic suspended-sediment sampler is installed at the Wilson Creek station.

Air temperature, relative humidity, precipitation, soil temperature, wind, and solar radiation are measured at the climatological station operated in Wilson Creek basin. A second precipitation gage is operated in the headwaters of Wilson Creek and a third precipitation gage is scheduled to be installed on the Taylor-Wilson Creek divide after the Colowyo mining plan has been finalized. Snow course data are also collected.

Distribution of Funds:

Salaries	$24,300
Travel	2,100
Equipment (replacement)	800
Operation and maintenance of gages (including data storage)	10,000
Laboratory Analyses	12,000
Data Processing	2,700
	$51,900

3. Hayden Gulch: For FY 80 the hydrologic monitoring program will be continued with data collected on surface-water quantity and quality, ground-water quality and potentiometric surface levels, and area climate.

Hayden Gulch, between Foidel-Middle and Taylor-Wilson Creeks, has been chosen to complete the hydrologic network for northwestern Colorado.

Hubberson Gulch and Watering Trough Gulch were selected as basins with proposed coal development. Stokes Gulch, selected as being representative of the dryland-farming areas of the region, will provide data to compare the hydrologic impacts of coal development with those of Yampa Basin agriculture development.

A surface-water gaging station, installed on Stokes Gulch, will be continuously monitored for discharge, water temperature, and specific conductance data. Monthly water samples will be collected and analyzed for major chemical constituents, while quarterly water samples will be collected and analyzed for major constituents and trace metals. Monthly sediment samples will be collected at the Hayden Gulch stations. Sediment samples at the Stokes Gulch station are collected by an automatic suspended-sediment sampler.

Distribution of Funds:

Salaries	$33,000
Travel	3,500
Operation and maintenance of gages (including data storage)	6,000
Laboratory	12,000
Data Processing	2,000
	$56,500

C. Hydrologic Modeling Total Funding: $167,300

II. Ground-Water Studies, Coal-Bearing Aquifers in Colorado:

A. Location: Colorado

B. Objectives: To define the hydrologic properties of major coal-bearing aquifers so potential impacts of coal mining can be evaluated. These areas include Milner, Rattlesnake Butte, Hayden, Hayden Gulch, Breeze Mountain, Hamilton, Round Bottom, and Horse Gulch. Total emphasis will be to collect enough data so that the entire hydrologic regime can be analyzed. Some work will be carried out on active sites.

Phase two of the program initiated in the summer of 79 consisted of aquifer testing, water-quality sampling, baseflow determinations, and hydrologic reconnaissance in areas designated by BLM. In FY 80 data in areas of high priority will be collected.

C. Report Products: Raton Basin basic-data report is in preparation.

D. Distribution of Funds:

Salaries	$ 50,957
Travel	14,651
Laboratory Costs	11,297
Drilling and Aquifer Testing	49,101
Computer Costs	5,597
Equipment	18,397
	$150,000

III. Hydrology and Reclamation Potential of Coal Spoil Piles:

A. Location: Routt County, Colorado

B. Objectives: Three-fold. First, the hydrologic characteristics of coal spoils piles will be defined, and the quantity, quality, and timing of water movement through the spoils will be examined and compared to the same parameters for undisturbed basin areas. Hydrologic data collected will be used to develop a model to predict impact of coal development on the quantity and quality of water leaving a mined basin. In addition, the model will aid in assessing reclamation potential of disturbed areas by providing a complete annual water balance for those specific basin areas.

The second objective will be assessing use of cuttings from holes drilled in undisturbed areas to predict the water-quality changes that will occur after mining these areas. Water-quality changes in existing spoils piles will be compared to quality changes in water passed through a column of cuttings from adjacent areas. This technique would provide a relatively inexpensive method for predicting water-quality changes in areas to be mined. These data would then be used in the hydrologic simulation model to predict the impact of mining on total basin hydrology.

The third objective is to examine effects of reclamation procedures on spoils-piles hydrology. Different land-surface treatments and vegetative covers will be applied and evaluated to determine their effectiveness in reclaiming disturbed areas, their specific water requirements, and their water-quality impact. This objective will not be examined until objective one is met.

Spoils-piles hydrology is monitored using a combination of lysimeters (installed in the upper 8 feet of the spoil profile) and observation wells. Five lysimeters are installed in a reclaimed spoils area and 4 sets of 6 porous cup lysimeters are installed in an undisturbed area. Soil-water regimes within the lysimeter and adjacent areas are monitored using access tubes and a neutron soil-moisture probe.

Three holes are drilled in the existing spoils pile to total mined depth (about 50 feet), and 4 holes have been drilled to a mined coal depth in adjacent undisturbed areas. All holes will be completed as observation wells and periodic water samples will be collected for analysis of major chemical constituents and selected trace metals. Water-quality changes within the total depth of spoils will be determined from these samples. Cuttings from each hole will be collected and used to construct laboratory columns which represent these holes. Three pore volumes at a time will be added to columns and water-quality analysis will be run on collected water samples. Water sample analyses from column runs will be related to lysimeter run results and sample analyses for observation wells in the spoils. Relationships between water-quality changes in columns and those observed in the field will show feasibility of a rapid, relatively inexpensive method for predicting water-quality changes in areas to be mined.

The Hydrology of Coal Spoils Piles project has been operating since 1976 and operates 8 ground-water wells in the immediate area. Due to the large financial investment for equipment and the fact that all equipment is in place and operational, it is recommended that the project be continued for at least 2 more years. This would add valuable definition to any trends toward a steady state. After trends have been established it would be useful to continue the project on a reduced basis for monitoring long-term effects (3-5 years). The water-quality sampling work which was previously done by the Ground Water project (see Section II) will now be done on this project.

As of FY 1980 additional studies will be performed at the mine site, monitoring spoil-pile water quality in the saturated zone and water movement in the unsaturated zone. Three ground-water observation wells and 3 soil water access tubes, which will monitor soil water content in the unsaturated zone, will be installed to spoil-pile depth. The wells will have continuous water-level recorders in place, and water-quality samples will be taken. A study report will be available at the end of FY 1982.

C. Report Products: A publication, planned for 1980, will report all data collected, procedures developed, data analyzed, and models developed.

D. Distribution of Funds:

1980 Salaries	$ 68,300
Travel	8,250
Vehicles	6,500
QW Samples	21,700
Computer	4,000
Installation, operation and maintenance of data collection equipment (including data storage)	16,250
	$125,000

IV. Hydrologic Characterization of North Park:

A. Location: Jackson County, Colorado

B. Objective: To define hydrologic system of the study area, interrelating surface flow, ground-water movement, precipitation, and climate. The availability and quality of surface water will also be defined. Ground-water data, available from the ground-water level monitoring program, will be related to present and future mining operations to assess the effects of mining on basin hydrology.

Data collection continued at 5 sites in the Coalmont study area, operated in cooperation with Jackson County and not funded with EMRIA funds. Continuous streamflow records were obtained, while water-quality and sediment samples were collected on a less than monthly schedule.

An intense data collection program, begun at the 2 EMRIA sites on the Canadian River following their installation, is obtaining continuous records of streamflow, sediment, discharge, water temperature and specific conductance. Monthly water samples are being analyzed for major chemical constituents, quarterly samples for organic carbon, and semi-annual samples for trace metals.

A site-specific study was begun in April 1979 in the McCallum lease area, where the first lease will be let. The site-specific study should be continued to assess any hydrologic changes associated with the mining. A streamflow station and two rain gages were installed and operated on Williams Draw during FY 1979 with USGS funds.

A climatological station was also installed in the Canadian River study area in 1979. Data regarding temperature, soil moisture, wind run and precipitation can be used to evaluate the overall hydrology or to assess the reclamation potential of mined areas. Climatological data should be collected for the duration of the study as a gage addition on a small basin has upgraded the area to a modeling status.

C. Report Products: All surface-water data will be published annually in "Water Resources Data for Colorado." An interpretative report covering the Coalmont and Canadian River areas will be published at the conclusion of the study in 1982-83. A preliminary hydrologic assessment report of the McCallum area will be available in March 1980 to incorporate into an EIS for that proposed lease.

D. Distribution of Funds:

Salaries	$25,000
Travel	7,000
Equipment	1,500
Laboratory Analyses	12,000
Operation and Maintenance of gages (including data storage)	12,000
Report--EMRIA site study	3,000
	$60,500

V. Hydrologic Characterization of Raton Mesa:

A. Location: Las Animas County, Colorado

B. Objective: For FY 80 the hydrologic monitoring program will continue operating the detailed site-specific study areas, which were selected based on their representing areas to be surface mined and their potential for being mined within the next 3 to 5 years. These sites are Mulligan, Carpios, and Molino Canyons.

Surface-water gaging stations with concrete flumes were installed on all three basins. Monthly water samples will continue to be collected at each station and analyzed for major chemical constituents. Quarterly water samples will be collected at each station and analyzed for major constituents and trace metals. Sediment samples were collected by automatic suspended-sediment samplers.

Climatological stations, which will continue operating in Mulligan and Molino Canyons, measure air temperature, relative humidity, precipitation, soil temperature, wind, and solar radiation.

Distribution of Funds:

Salaries	$ 5,200
Travel	4,650
Equipment	5,400
Laboratory	25,750
Operation and maintenance of stations (including data storage)	44,000
Computer	4,000
	$89,000

C. Report Products: All data will be published annually in "Water Resources Data for Colorado." An interpretive report will be published at the conclusion of the study in 3 to 5 years. In addition, a general preliminary data analysis report will start in FY 80.

VI. Hydrologic Characterization of Collom Gulch, Yampa River Valley, Colorado:

A. Location: Moffat County, Colorado

B. Objective: Study plan is now being developed in cooperation with BLM personnel. Specific work plan will be written by December 1979.

C. Distribution of Funds: $70,000

VII. Colorado Salinity Program:

A. Evaluation of Salinity Potential of Mancos Shale Lands:

1. Location: Three study sites: (1) observation reservoir 4-A, Prairie Dog Site; (2) observation reservoir No. 12, Middle Basin Site; (3) observation reservoir No. 2-A, West Twin Site; in Badger Wash near Mack, Colorado.

2. Objectives:

a. Operate the gages April 1 - October 31 each year, collect samples, tabulate the streamflow, water quality and rain gage data. The streamflow gages will be operated on a 5-minute punch interval (with peak-stage indicator). The water sampler will be set to collect a sample every 5 minutes during the runoff period. It is estimated that about 10 samples per site be taken after the first runoff event and 3 samples per site for approximately 3 other storms per year will be collected and analyzed.

b. Run topographic survey of each reservoir at each runoff season end.

c. Equipment purchased to aid this contract shall become BLM property at the study end.

3. Report Products:

a. Provide BLM with copies of all tabulated data as it is completed. All discharge and water-quality data will be published annually in "Water Resources Data for Colorado".

b. Data from total rainfall, runoff, sediment yield and water quality carried into the reservoir for each site will be compiled and summarized, and then submitted to BLM.

4. Distribution of Funds:

Salaries	$ 7,790
Travel	700
Vehicles	725
Supplies and Equipment	650
Data Processing	7,255
	$17,120

B. Colorado Water-Quality Stations:

1. Location: Nine gaging stations - 2 on West Salt Creek, 2 on Potter Creek, 1 on West Gypsum Creek, 1 on Vermillion Creek, 2 on Onion Creek, which flows out of Fisher Valley in Utah, and 1 on Salt Creek, which flows out of Sinbad Valley in Colorado.

2. Objectives: Each station consists of a digital water-level recorder to measure stream stage and Manning sampler to obtain water quality and sediment samples. A stage-discharge relationship will be developed for each site from current and slope-area measurements. Each station will be inspected weekly with streamflow measurements and water-quality samples obtained at least monthly. These stations will provide data on streamflow quantity and the chemical character of the water in these streams.

3. Report Products: Provide BLM with copies of all tabulated data as it is completed. All discharge and water-quality data will be published annually in "Water Resources Data for Colorado".

The saline springs located along Salt and Onion Creeks were sampled in March and April 1979. Five sites along Salt Creek and 6 sites along Onion Creek are scheduled for monthly measurements and water-quality samples.

The gain-loss investigations along these creeks will be conducted at the end of the snowmelt runoff period.

4. Distribution of Funds:

Operation of 9 surface-water stations @ $2,600	$23,400
Operation of 9 water-quality and sediment stations @ $3,250	29,250
Quality of Water Laboratory Analysis	12,600
	$65,250

VIII. Operation of BLM Stations in San Luis Valley:

A. Location: Six study sites in San Luis Valley: (1) 2 reservoir sites - change in contents, (2) 2 reservoir sites - inflow, (3) 2 daily streamflow sites on Ford Creek. Sediment surveys on 4 reservoirs. Recording rain gages at 6 sites and miscellaneous rain gages in basins.

B. Objective: To determine effects of changes in land use on the runoff and sediment load from the small drainage areas. Daily flow and rainfall will be tabulated for the 4 reservoir sites, and an annual sediment load survey will be made. Two streamflow and rainfall sites are located on Ford Creek to monitor runoff in this area.

C. Distribution of Funds: CO-050-4340-5225

Salaries	$19,050
Travel	1,050
Vehicles	950
Supplies and Equipment	500
Data Processing	1,800
	$23,350

Idaho

IDAHO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA	OTHER
O&M of 4 Gaging Stations	---	$10,140
Skew Coefficients Study	---	8,000
		$18,140

IDAHO

I. Operation and Maintenance of Four Gaging Stations.

A. Location

1. Herd Creek
2. Lolo Creek
3. Birch Creek (2) partial-year records

B. Data Collection: To begin December 1979 or January 1980 and to continue for a five-year period.

C. Reports: To be published in the USGS "Water Resources Data for Idaho."

D. Funding: FY 80. Non-EMRIA.

Two stations @ 3,620	=	$ 7,240
Two stations @ 1,450	=	2,900
		$10,140

II. Skew Coefficients for Flood-Frequency Curves for Idaho Streams.

A. Location: Selected Idaho streams.

B. Data Collection: To start in November 1979.

C. Report: Will include a map of generalized skew coefficients, discussion of procedures, data used, results, use of the skew map and other pertinent information.

D. Funding: BLM share only, non-EMRIA: $8,000.

Montana

MONTANA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT		EMRIA		OTHER
Hydrologic Characterization		$216,970		---
EMRIA Site Studies		124,930		---
Surface/Water-Quality Data Analysis				
Salinity Modeling, Tongue River	$32,800			
Network Analysis	17,300			
Channel Geometry	13,000			
Surface-Water Flow Analysis	37,500			
		100,600		
Hydrologic Modeling		89,500		
Test Drilling & Aquifer Testing		174,600		
Other Studies (MT-930-4340-5273)		---		$30,000
TOTALS		$706,600		$30,000
TOTAL STATE OF MONTANA			$736,600	

MONTANA

I. Hydrologic Characterization of Southeastern Montana Coal Areas

A. Network Maintenance of Stream-Discharge and Water-Quality Monitoring Sites

1. Objectives: Collect streamflow and water-quality data at key locations to supplement other programs. The data is essential in defining runoff from potential impact areas, determining streamflow characteristics, and providing a data base from which future changes can be analyzed.

2. Procedure: Standard U.S. Geological Survey methods of surface-water and quality-water data collection will be used to obtain data at the following stations:

East Fork Trail Creek (2 stations)
Beaver Creek near Wibeaux
Cherry Creek near Terry
Rehder Creek near Klein
Halfbreed Creek near Klein
Musselshell River near Roundup
East Parrot Creek near Roundup
West Parrott Creek near Roundup
Fattig Creek near Delphia
East Fork Armell's Creek near Colstrip
Armell's Creek near Forsyth
Rosebud Creek at Kirby
Rosebud Creek near Colstrip
Snyder Creek near Brandenberg
Rosebud Creek at Mouth near Rosebud
Spring Creek near Decker
Tongue River below Tongue River Dam
East Fork Trail Creek
Prairie Dog Creek near Birney
Hanging Woman Creek below Horse Creek
Otter Creek near Otter
Otter Creek below Fifteen Mile Creek near Otter
Home Creek near Ashland
Tongue River below Brandenberg Bridge near Ashland
Pumpkin Creek near Miles City
Glendive Creek near Glendive
Cottonwood Creek near Intake
Beaver Creek near Wibeaux
Trail Creek above coal deposits near Otter
Corral Creek near Otter
Horse Creek near Otter
Waddle Creek near Otter
Hanging Woman Creek near Stateline
Locate Creek near Locate
Cow Creek near Colstrip

3. Report Procedures: Basic records from streamflow and surface-water quality sites will be submitted to BLM annually or as mutually agreed upon. Records will be published by the USGS in an annual basic data report, "Water Resources Data for Montana." The data will be used by the USGS in preparing interpretive reports described in other parts of the work plan.

4. Relationship to Other USGS Studies: This program will supplement and be correlated with other USGS programs of streamflow and surface-water quality data collection. Other stations operated in this area include:

   Redwater River at Circle
   O'Fallon Creek near Ismay
   Upper Seven-Mile Creek near Glendive
   Custer Creek near Kinsey
   Crow Rock Creek near Rock Springs
   Deer Creek near Glendive
   Muster Creek near Kinsey
   Clear Creek near Hoyt
   Redwater Creek near Vida
   Mizpah Creek near Mixpah
   Nelson Creek near Van Norman
   Prairie Elk Creek near Oswego
   Squirrel Creek near Decker
   Burns Creek near Savage
   Half Breed Creek near Roundup
   Sarpy Creek near Hysham
   Hanging Woman Creek near Birney
   Otter Creek at Ashland

5. Distribution of Funds:

Salaries	$ 71,100
Lab Services	34,730
Travel	44,410
Supplies	5,100
Data Processing	11,600
	$166,940

B. Sediment Data Collection

1. Objectives: Collect sediment data downstream from areas where problems may be encountered from lease areas. The data is essential in defining present sediment loads from which future changes can be analyzed.

2. Procedures: Suspended-sediment samples will be collected and analyzed using standard USGS methods at the following streamflow monitoring site:

   Tongue River below Brandenberg Bridge near Ashland

3. Report Products: Basic records will be submitted to BLM annually or as mutually agreed upon. Records will be published by the USGS in an annual basic data report, "Water Resources Data for Montana."

4. Relationship to Other USGS Studies: This program will supplement and be correlated with other USGS sediment data collection programs. The USGS operates sediment stations at the following sites:

   Yellowstone River at Billings
   Yellowstone River at Forsyth
   Tongue River at Miles City

5. Distribution of Funds:

Salaries	$3,510
Travel	2,170
Laboratory Services	1,880
Data Processing	240
	$7,800

C. Ground-Water Monitoring

1. Location: Fort Union coal region of eastern Montana. New ground-water study sites for 1980 include:

   a. Timber Creek, Big Dry Resource Area, Circle West KRCRA; T. 19 N., R. 44 E. T. 18 N., R. 44 E. T. 19 N., R. 45 E.

   b. Horse Creek, Powder River Resource Area, Hanging Woman KRCRA; T. 8 S., R. 43-44 E.

   c. Bear Creek, Powder River Resource Area, Morehead KRCRA; T. 8 S., R. 45 E. T. 8 S., R. 46 E.

   d. Burns Creek, Big Dry Resource Area, Burns-13 Mile KRCRA; T. 20 N., R. 56 E. T. 20 N., R. 57 E.

   e. Beaver Creek; Powder River Resource Area, T. 1 S., R. 45 E.

   f. Sand Creek, Big Dry Resource Area, W. Glendive KRCRA; T. 15 N., R. 54 E.

2. Objectives: To provide ground-water data base from which an assessment can be made of the resource, future responses to stresses can be predicted, and pollution and supply problems can be detected and defined. This activity provides for long-term collection of ground-water data from selected observation wells. Specifically, wells monitored in EMRIA study sites are incorporated in this program to extend data collection periods.

3. Procedures:

a. Make water-level measurements and continue operation of water-level recorders.

b. Compile and analyze data.

c. Collect ground-water samples from selected wells.

d. Analyze water samples.

4. Report Products: Data collected under this program will be incorporated in EMRIA Site Study reports and in regional evaluations. The data will be stored in automated data files for rapid retrieval.

5. Relationship to Other USGS Studies: Data collected under this activity will be used to help define pre-mining conditions of reclamation study sites, help calibrate ground-water models to predict the effects of mining, and help transfer data to surrounding areas from intensively studied reclamation sites.

6. Distribution of Funds:

Salaries for Data Collection	$10,800
Laboratory Services	12,950
Travel	13,440
Data Processing	5,030
	$42,220

D. Hydrologic Characterization: Total Funding $216,970.

II. EMRIA Site Studies

A. Locations: During FY 80, potential lease areas known as Ashland, West Otter, Sweeney-Snider, and Corral Creek will be studied. Preliminary analysis of proposed sites in the Big Dry Resource Area or other high priority sites will be made.

B. Objectives: To collect and evaluate hydrologic data at potential coal-lease area sites for activity planning in the Powder River and Fort Union coal regions. The studies are designed to compile available hydrologic information, design and implement site-specific data collection programs, coordinate data collection activities with other agencies and private companies, and evaluate the potential hydrologic impacts of mining and reclamation.

C. Procedures: Available hydrologic data will be compiled and evaluated. Data collection networks will be designed and implemented to acquire information. Where data are lacking, test drilling programs will be outlined to obtain the needed information. In the Otter Creek site, a test study to evaluate the effects of mining on alluvial valley floors will be implemented.

D. Report Products: A report summarizing the hydrologic data and presenting the interpretations of hydrologic conditions in each site will be prepared. In most cases, a USGS Water Resources Investigation Report would be the intended publication media, but BLM-EMRIA reports may be used as the publication release.

E. Distribution of Funds:

Salaries:	
Data Collection	$ 52,500
Data Analysis	32,250
Travel	27,220
Computer	5,760
Laboratory	4,320
Equipment	2,880
	$124,930

III. Salinity Modeling of Tongue River

A. Location: Tongue River below Tongue River Dam.

B. Objectives: To construct and calibrate a digital model of the Tongue River which will simulate the river salinity through and downstream from existing and proposed mines. The model would be useful in simulating salinity in the river under various conditions of flow and development. This model would provide a tool for evaluating cumulative, off-site effects of various mine operations.

C. Procedures: Various salinity models will be evaluated and the most applicable one will be selected for use on the Tongue River. Depending upon the model selected, data collection will be designed and implemented to obtain the necessary input information. Time-of-travel, an essential item in any analysis of surface-water quality, will be measured at various river stages. Cross-section information, diurnal water-quality fluctuations, ground-water quality conditions, and other data will be acquired. The input data will be used to calibrate the selected model and various development scenarios will be simulated.

D. Report Products: A final report summarizing the finding of the investigation will be prepared for release in the USGS Water Resources Investigations Series. It will contain the hydrologic data collected, will outline the modeling techniques used, and will present the simulation runs performed.

E. Relationship to Other USGS Studies: This program will bring together the results of several previous and ongoing studies including runoff monitoring, surface-water quality monitoring, ground-water--surface-water interrelation studies, and runoff modeling activities. The work will be supplemented with $30,400 in USGS Coal Hydrology funds.

F. Distribution of Funds:

Salaries	
Data Collection	$ 9,100
Data Analysis	11,760
Travel	3,370
Laboratory	5,680
Computer	2,170
Equipment	720
	$32,800

IV. Network Analysis

A. Location: Fort Union coal region in eastern Montana.

B. Objectives: Numerous water-quality stations have been operated throughout the Fort Union coal region to obtain basic data needed to evaluate the impacts of mining and the potential for reclamation. Analysis of the data is needed to define geochemical processes, determine relationships, and evaluate the necessity of modifying the network. In addition, modeling techniques should be applied to evaluate regional relationships between water quality and land use, geology, and runoff.

C. Procedures: Statistical methods will be used to evaluate the surface-water quality data. Regression techniques will be applied to determine station correlations. Data collected from existing stations will be evaluated to determine the desirability of continuing, modifying, eliminating, or replacing stations to insure that monitoring sites provide the necessary information. Regional analysis and modeling techniques will be applied to define cause-effect relationships between water-quality and basin characteristics.

D. Report Products: Investigation results will be used to modify the existing surface-water quality monitoring network in the Fort Union coal region. A report summarizing the statistical correlations and regression analyses will be published in the Water Resources Investigations Series.

E. Relationship to Other USGS Studies: This activity extends the surface-water quality monitoring program to include reduction, analysis, and interpretation of data. In raw form, data from the monitoring program is of limited usefulness. By reducing the data to an easily understood form, analysis and interpretation are possible. Thus, this project greatly increases the usefulness of data collected under other programs. Results of this activity insure collection of meaningful information. USGS Coal Hydrology funds will supplement this project with $20,500.

F. Distribution of Funds:

Salaries	$14,390
Computer Costs	2,910
	$17,300

V. Channel Geometry Investigations

A. Location: Fort Union coal region.

B. Objectives: To develop channel geometry equations which relate streamflow characteristics to channel features in the prairie environment of eastern Montana.

C. Procedures: Various channel features including width, depth, slope, and particle-size distribution of bed and bank material will be measured at selected sites where streamflow has been measured. Regression equations relating channel geometry measurements to streamflow will be developed and evaluated. The transferability of the developed equations will be tested using short-term stream gaging sites at selected locations. The information collected in Montana will be supplied to researchers in the Central Region for use in developing regional channel geometry equations.

D. Report Products: In addition to providing the information to regional staff, the District will prepare a report summarizing the study findings. The report will contain an explanation of the principles involved, instructions on field measurement techniques, a presentation of the regression equations developed, and an analysis of the accuracy of the technique.

E. Relationship to Other USGS Studies: This study is closely coordinated with and supplements the regional research project on channel geometry under R.E. Hedman. Much of the data acquired as part of the District program will be used by Hedman in developing regional channel geometry equations.

F. Distribution of Funds:

Salaries:	
Data Collection	$ 2,500
Data Analysis	8,000
Travel	1,000
Computer Costs	1,500
	$13,000

VI. Surface-Water Flow Analysis

A. Location: Fort Union coal region.

B. Objectives: To develop techniques for estimating streamflow characteristics at ungaged sites in eastern Montana. To conduct studies in selected high priority coal lease sites to estimate runoff, peak flows, and flood boundaries.

C. Procedures: Numerous techniques have been suggested for estimating various streamflow characteristics at ungaged sites. An attempt will be made to define mean annual runoff, peak flows, and recurrence intervals for selected sites throughout the coal area of eastern Montana. At some sites, flood boundaries must be defined relative to strip mine operations. This project provides funding to develop the streamflow characteristics at ungaged sites and to define flood boundaries at selected high priority coal lease sites. Best available techniques will be used which could include regional equations, channel geometry techniques, crest-stage gage information, and regional runoff maps or rainfall-runoff models. Available information, local topography, geologic conditions, proximity to long-term gaging stations, and similar factors will be considered in selecting the most applicable methods to be used.

D. Report Products: In general, study results will be included as parts of EMRIA site studies. For some areas, flood prone area maps may be prepared for open-file release. No final report is anticipated, but state-of-the-art technical papers may be prepared for publication in journals.

E. Relationship to Other USGS Studies: This project is closely related to stream gaging networks including benchmark stations, short-term monitoring stations, miscellaneous sites, and crest-stage gages. The results of channel geometry work and the rainfall-runoff modeling projects will be used in estimating runoff at ungaged sites. The USGS Coal Hydrology Program will supplement this project with approximately $21,600.

F. Distribution of Funds:

Salaries:	
Data Collection	$12,700
Data Analysis	16,080
Travel	5,040
Computer	2,880
Equipment	800
	$37,500

VII. Hydrologic Modeling

A. Location: Prairie Dog Creek watershed in southeastern Rosebud County has been selected as the study site.

B. Objectives: The USGS has developed rainfall-runoff models which accurately predict runoff from storm events in some environments. However, the models have been developed for use in geologic and climatic conditions quite different from the prairie environment of Montana's coal region, so the USGS is attempting to modify existing models to be responsive to the climatic and geologic conditions which prevail in eastern Montana. The Montana District, in conjunction with other WRD districts and Regional research hydrologists, will pursue problems related to runoff from snowmelt and for rainfall on frozen ground and other situations more appropriate to the northern plains region. Hopefully, the modified model can be calibrated for the Prairie Dog Creek watershed to verify its suitability for this area. If successful, the model will be extremely useful in evaluating the effects of land-use changes such as strip mining or reclamation on run-off from small drainages.

C. Procedures: The Prairie Dog Creek watershed has been instrumented with climatological and soil-moisture monitoring equipment to determine various parameters for modeling. Precipitation gages have been installed, soil-moisture access tubes have been emplaced, soil-temperature probes have been planted, stream gaging stations have been constructed, and monitoring of various parameters has begun. Data will be processed and modeling will begin. Because Prairie Dog Creek will probably not be mined in the near future, a second study area will be needed to obtain post-mining runoff data. A contract to an outside agency or study group to acquire data is proposed to obtain the required verification data.

D. Report Plans: Data collected as part of this study will be extremely valuable to researchers in other agencies and to universities. To make this data useful to others, a series of basic data reports is planned to release climatological, soil, and streamflow data. Progress reports describing activities and work accomplished are planned for open-file release. A final report describing the research and results is planned in cooperation with other WRD districts. The final report will probably be published in the Professional Paper series to allow wide distribution.

E. Relationship to Other USGS Studies: This project complements other programs in the Montana District. One currently troublesome aspect of rainfall-runoff modeling, for example, is the relationship of streamflow to ground-water systems. Work on the ground-water aspects of the study area being funded under another project will be extremely useful in evaluating the relationship of infiltration and ground-water discharge to streamflow. Several other WRD districts are involved in modifying existing runoff models to simulate various climatic, geographic, and geologic settings. Montana's work will be closely coordinated with these districts to minimize duplication, exchange information, and share experience and equipment.

F. Distribution of Funds:

Salaries	$31,180
Travel	16,800
Computer Costs	8,190
Laboratory	4,300
Equipment	9,760
Data Processing	4,880
Contract for Verification Data	14,390
	$89,500

VIII. Grant to Montana Bureau of Mines and Geology for Test Drilling and Aquifer Testing in High Priority Lease Areas and Investigations of the Soluble Salts in Coal Overburden and the Qualities of Ground Waters in Spoils.

A. Location: Fort Union coal region near Ashland, West Otter Creek, Corral, and Sweeney-Snyder coal lease area.

B. Objectives: To drill test holes, install casing, conduct aquifer tests, and monitor water levels at selected sites in high priority lease areas. This grant provides for collecting ground-water data in areas where data are needed to evaluate effects of mining and potential for reclamation. The objective of the soluble salts study is to develop techniques for predicting probable ground-water quality resulting from surface mining of coal.

C. Procedures: After initially evaluating existing data, locations where additional information is needed will be selected. The Montana Bureau of Mines and Geology will drill test holes at the selected sites, install casing, conduct aquifer tests, collect water samples, and monitor water levels. Additional research wells will be installed in spoils at the Decker, Rosebud, and Big Sky mines. Following installation, the wells will be tested by pumping to determine hydraulic conductivity values and to obtain samples for quality analysis. Selected wells will be equipped with continuous water-level recorders. Some will be re-tested periodically to determine transmissivity and water-quality changes that occur due to changes in saturated thickness. Compaction due to saturation occurs continuously in the spoils and will be examined periodically through use of refraction-seismograph techniques to determine effects on spoil transmissivity and water quality at selected research wells.

Overburden and spoils samples will be collected by coring and grab-sampling and will be submitted for laboratory leaching and paste-extract analyses.

Water-level and water-quality data will be added to the computer file for statistical and trend analyses. Determination of salts available for dissolution from overburden materials will be made from chemical analyses of water-saturated-paste extracts of core samples. In addition to the suite of cations routinely run in these analyses, determinations of sulfate concentrations will be made; chloride can be assumed insignificant, so bicarbonate content will be estimated by subtraction. Column-leach tests will be conducted on some of the materials, and chemical analyses of the leachates will be used to validate the extract chemistry. For the saturated pastes and leach tests, both distilled water and site-collected ground and surface waters will be used. During the leach tests, leachate quality will be carefully monitored to define rates of salt removal. Type curves will be generated for dissolution rates to characterize hypothetical rates of salt removal from mine spoils.

D. Report Products: Field data will be compiled in a report describing the results of drilling and testing. Montana Bureau of Mines and Geology will submit the report to USGS for distribution to BLM. Annual progress reports for the soluble salts study will describe activities and results after each of the first 2 years. At the end of the third year, a final report will summarize the research and will include a recommended technique for predicting spoil-water quality. Additional communications during the project period will probably also be necessary to provide input to off-site transport models being developed by other researchers.

E. Relationship to Other USGS Studies: The grant provides basic geologic and hydrologic data needed for completion of EMRIA site studies. Without the information from this program, definition of the ground-water systems would be difficult.

F. Distribution of Funds:

Grant to Montana Bureau of Mines and Geology	$174,600

IX. Other Studies: (MT-930-4340-5373)

Reservoir Surveys

A. Location: Powder River and Big Dry Resource Areas

Reservoir Name	Location	County
Sidney Reservoir	T. 5 S., R. 59 E., Sec. 29	Carter
Jack Rabbit Detention Dam	T. 2 S., R. 58 E., sec. 13	Carter
Ridge Reservoir	T. 5 S., R. 57 E., sec. 1	Carter
Side Hill Reservoir	T. 9 S., R. 57 E., sec. 34	Carter
Clark Reservoir	T. 13 N., R. 48 E., sec. 18	Prairie
Grant Reservoir	T. 13 N., R. 48 E., sec. 21	Prairie
Pasture #1 Reservoir	T. 11 N., R. 52 E., sec. 2	Prairie
Coldwell Reservoir #2	T. 21 N., R. 40 E., sec. 10	Garfield
Mid-Flat Creek Reservoir	T. 21 N., R. 40 E., sec. 4	Garfield
Homestead Reservoir	T. 14 N., R. 49 E., sec. 7	Prairie
Coal Creek Reservoir	T. 13 N., R. 51 E., sec. 35	Prairie
Big Drop Reservoir	T. 13 N., R. 56 E., sec. 9	Dawson
Pass Creek Reservoir	T. 21 N., R. 40 E., sec. 5	Garfield

B. Objectives: To undertake a limnological reconnaissance of the above lakes and reservoirs in Garfield, Prairie, Carter, and Dawson Counties, Montana. This study is to provide water-quality data that would help determine the types of uses suitable for these small reservoirs. Reservoir uses under consideration by BLM include:

1. Livestock watering.

2. Waterfowl production.

3. Fish propagation.

4. Body contact recreation.

C. Approach: Thirteen reservoirs in the study area will be sampled in FY 80. The following sampling periods were chosen to study each reservoir when limnological conditions are most critical to the proposed reservoir uses:

1. Late winter, when ice cover prevents exchange of gases with the atmosphere.

2. Early spring, when ice cover is gone, the reservoirs are completely mixed, and peak inflow has occurred.

3. Late summer, when there is a possibility of stratification of the reservoir water and development of anoxic conditions in the hypolimnion.

Measurements of light penetration will be made at each reservoir during each visit as an indication of the relative amount of suspended material in each reservoir. Depth profiles of each reservoir will be made for temperature, dissolved oxygen, specific conductance, and pH.

To further characterize each reservoir, the concentrations of selected chemical constituents will be determined for the spring and late summer visits. Chemical analyses will include: (1) major dissolved constituents--calcium, magnesium, potassium, sodium, bicarbonate, chloride, fluoride, silica, and sulfate; (2) trace elements (dissolved) of primary concern in the area--boron, copper, iron, lead, manganese, and zinc; and (3) plant nutrients--dissolved orthophosphate, dissolved phosphorus, total phosphorus, dissolved organic carbon and suspended organic carbon. During the late summer visit, trace elements of secondary concern--arsenic, barium, cadmium, chromium, cobalt, mercury, nickel, selenium, silver, and vanadium--will also be determined.

Phytoplankton and bacterial samples will be collected and analyzed from each reservoir in late summer to reflect the quality of life each reservoir is supporting.

Field measurements for dissolved oxygen, temperature, specific conductance, and pH will be made at 1-m intervals using a Martek water-quality instrument near the outlet or middle of each reservoir (the deepest site). Light penetration at each sampling site will be measured using an 8-in (20-cm) diameter Secchi Disk.

Water samples for chemical analysis will be collected near the bottom and surface of each reservoir site using a Kemmerer water sampler and will be field treated for preservation. Field parameters will be determined at the site and laboratory samples will be analyzed at an accredited laboratory.

Phytoplankton will be collected from each reservoir using a plankton net with a .202-mm mesh opening. Samples will be collected by towing the plankton net vertically the full depth of water at each site. Phytoplankton invertebrates will be analyzed at a private laboratory. Procedures for the preservation and analysis (identification and enumeration) of phytoplankton will follow methods described by Slack and others (1973).

Total coliform, fecal coliform, and fecal streptococcus bacteria will be collected from grab samples of water at each chemical sampling site and near the shore of easiest access to each reservoir. Field analysis of bacterial samples will follow techniques described by Slack and others (1973).

Field work for the proposed study of reservoirs in the study area will begin the winter of FY 80. Samples will be collected by USGS District Office personnel. The project chief will devote approximately 6 man weeks of effort during FY 80 and he will be supported by District Office field personnel.

D. Reports: A basic data report covering the reservoirs sampled will be available for review in early FY 81.

The final report covering the reservoir sampling described herein will be available for review in early FY 81 and in final form before the end of FY 81.

E. Distribution of Funds:

Salary	
Data Collection	$ 4,800
Data Analysis	2,650
Lab Charges	11,450
Travel	2,400
Computer Charges	600
Report Preparation	2,200
District Support	5,900
	$30,000

Nevada

I. Operation and Maintenance of Two Gaging Stations.

A. Location: Elko Co., Nevada
   1. Gance Creek at State Highway 51.
   2. Mahala Creek at State Highway 51.

B. Data Collection:
   1. Daily discharges.
   2. peak discharges.
   3. Water temperature (periodic).
   4. D.O. (periodic).
   5. pH (periodic).
   6. Specific conductance (periodic).

C. Funding. Non-EMRIA FY80.

1.	O&M	$ 7,800
2.	Sediment	800
3.	Heavy metals (bottom sample)	900
4.	Low flow measurements	500
		$10,000

New Mexico

NEW MEXICO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA
Watershed Characterization	$ 12,700
Hydrologic Surveillance	137,900
Hydrologic Modeling-Kimbeto	61,500
	$212,100

NEW MEXICO

I. Watershed Characterization

A. Location: Coal-lease areas of northwestern New Mexico.

B. Objectives: To provide BLM with a method to estimate quantity and quality of runoff from small ungaged watersheds.

C. Procedures: Data on watershed parameters are continually being compiled and analyzed to develop relationships that estimate streamflow and water-quality characteristics from coal-lease areas. Parameters which are collected from gaged small watersheds, most of which have short periods of streamflow and water-quality records, include channel-geometry measurements, streambed material particle-size distribution, channel slope, infiltration rate of watershed and vegetative cover, drainage area, mean-annual precipitation, watershed slope, and basin shape.

Regression techniques are used to develop methods for predicting streamflow and water-quality characteristics from channel geometry and watershed characteristics.

This study will be closely coordinated with a regional watershed characterization study of strippable coal areas in the central and western United States. Objectives of the regional study are to: (1) test transferability of existing streamflow-basin relationships to coal-lease areas; (2) develop new relationships between streamflow characteristics and channel geometry and basin characteristics for ephemeral streams; and (3) develop similar relationships for estimating sediment and other water-quality transport characteristics for perennial and ephemeral streams.

D. Report Products: An administrative report will be updated defining significant relations for predicting streamflow and water-quality characteristics found by regression analyses prepared during FY 79. It will be considered an interim report since the relations will still be based on short periods of streamflow records. Subsequent reports will be updated annually based on longer periods of record or when additional relations are developed.

E. Distribution of Funds:

Salaries	$ 9,400
Travel	1,200
Laboratory Analyses	1,300
Data Processsing	800
	$12,700

II. Hydrologic Surveillance of Coal-Lease Areas

A. Location: Coal-lease areas of San Juan and McKinley Counties in northwestern New Mexico.

B. Objectives: To: (1) document hydrologic characteristics of streamflow and ground water in coal-lease areas and quantity and quality variabilities and (2) predict effects of coal extraction and associated development on water resources in northwestern New Mexico. This will aid BLM in their operations pertaining to coal-lease stipulations and land management practices of multiple purpose uses of the public domain.

C. Procedures: To operate and maintain established basic data collection sites to collect adequate water resources data. This will be done under natural or present conditions to establish a baseline for quantity and quality to predict effects of surface extraction of coal and related activities. Some of the areas at or near gaged sites will be mined so we can compare measured effects to predicted effects of surface mining for coal on water resources.

1. Surface Water: Established surface flow data collection sites to be operated during FY 80 include 5 streamflow sites. All sites have a set of 3 or 4 single-stage samplers for collecting water-quality samples at low, medium, high and flood stages.

   Three sites have 3 single-stage samplers, collecting replicate samples at each of 3 stages (9 single-stage samples per site). Replicate samples will be evaluated statistically to determine reliability of individual samples collected with single-stage samplers. These have been modified by the New Mexico District for sampling ephemeral streams containing extremely high suspended-sediment concentrations.

Established surface-water collection sites also include 8 partial record sites for collection samples inflowing into study areas from the main arroyo or side washes. Two of these partial record sites are equipped with peak stage gages.

We will continue to collect a comprehensive suite of water-quality parameters at least once annually at ephemeral flow sites and twice annually at perennial flow sites. These parameters will include major inorganic consitutents, trace elements, nutrients including organic carbon, radio-chemical parameters, and suspended-sediment data.

At perennial sites biological data also will be collected. Water-quality parameters, such as specific conductance, pH, suspended-sediment concentration and organic carbon, will be measured on additional samples because of their usefulness as index water-quality parameters. Other consitutents found in unusually high concentrations will also be analyzed more frequently. A minimum of 6 samples for partial chemical analyses from each site will be analyzed annually and as many flow events as possible will be sampled. Field personnel will collect samples if the site is found flowing, by single-stage samplers, or by automatic pump samplers.

2. Ground Water: Established ground-water data collection sites consist of 25 observation wells that are completed either in the coal, in the coal seam, or in the Pictured Cliffs and stone underlying the coal seam. We will measure water levels and collect samples from each well for complete chemical analyses at least once annually. After collection of sufficient samples over several years to define water quality in these wells, sampling frequency will be reduced if no water-quality changes are found.

D. Report Products: All data collected in the BLM-EMRIA program will be published by the USGS in "Water Resources Data for New Mexico." Water resources information that has been collected in the BLM-EMRIA program and other programs in the strippable coal areas will be analyzed to aid BLM in management decisions of coal-lease areas of the public domain in the interim prior to the release of comprehensive formal reports, such as water supply papers. Preliminary information on transfer techniques and interpretations of flow systems will be the subject of these studies, determined through close collaboration with BLM personnel. Proposed reports are:

1. Water-bearing characteristics of the overburden, coal, and underlying sandstone-shale of the Kirtland-Fruitland strippable coal trend in northwestern New Mexico. FY 80.

2. Thickness, water-bearing characteristics, and chemical quality of water in the Chaco River valley fill in northwestern New Mexico. FY 80.

E. Distribution of Funds:

Salaries	$ 78,600
Travel	9,700
Supplies & Equipment	16,500
Laboratory Analyses	30,300
Data Processing	2,800
	$137,900

III. Hydrologic Modeling-Kimbeto

A. Location: Small watershed control basin with drainage area of 8.2 sq mi within BLM's Kimbeto reclamation study area in northwestern New Mexico.

B. Objectives: To develop, calibrate, and verify precipitation-runoff models for predicting surface-runoff characteristics and sediment yield under various landuse conditions in the coal-lease areas. Emphasis will be on relating parameters used by the model to measurable physical features of a selected watershed basin. This will ease transferring the model from an instrumented to an uninstrumented basin.

C. Procedures: This watershed is instrumented to collect data for developing, testing, calibrating, and verifying precipitation-runoff models. Instrumentation includes a streamflow gaging station, an automatic pump sampler and single-stage samplers, a meteorological station, and 5 recording rain gages located for equal areal distribution over the basin.

Data collection and analyses for model development will be continued to define basin soil properties and detachability, soil-water storage characteristics, vegetation characteristics, and topography. Periodic inventory of soil-water storage will be made at 12 soil types identified in the watershed.

During FY 79, a hand-portable rainfall-simulating infiltrometer was used at 12 soil types and 3 partially reclaimed spoil piles to define infiltration, soil detachability, and water quality of the runoff. A field-portable rainfall simulator will be used on selected soil types and partially reclaimed spoil piles to define the infiltration rates, overland flow, and sediment yields from various combinations of topography, soils, vegetation, and land use. Collection of water-quality information at six sites on partically reclaimed spoil piles will be continued as part of this effort.

In addition to rain gages at the study basin, 3 operated in the strippable coal-lease area of northwestern New Mexico. Rainfall data from these rain gages and the rain gages at the study basin will be synthesized with a stochastic model to generate long-term rainfall data which will be one of the driving variables for the precipitation runoff model. The only long-term continuous-recording precipitation station available near this strippable coal-lease area is the National Weather Service Station at Farmington.

Data will be tested in the basic model developed by the Regional Precipitation-Runoff Modeling Project as it is being collected, which will aid in refining data collection techniques.

D. Report Products: An interim report will be prepared in 1981, when it is estimated enough data will be available for an initial calibration of the model. As additional data are collected and the model is improved and verified, the report will be updated and closely coordinated with efforts of the Regional Precipiation-Runoff Modeling Group of the Central Regional Office.

E. Distribution of Funds:

Salaries	$35,600
Travel	6,200
Supplies & Equipment	7,400
Laboratory Analyses	9,200
Data Processing	3,100
	$61,500

LIST OF WATER-QUALITY PARAMETERS[1] IN NEW MEXICO

Parameter	Annual for Ephemeral streams	Semi-Annual for Perennial streams	Six samples minimum annual for Ephemeral or Perennial streams	Annual for GW sites
Alkalinity			X	X
Arsenic			X	X
Barium	X	X		X
Bicarbonate			X	X
Boron			X	X
Cadmium	X	X		X
Calcium			X	X
Carbon, organic			X	X
Carbonate			X	X
Chemical oxygen demand	X	X		X
Chloride			X	X
Chromium	X	X		X
Coliform bacteria, fecal		X		
Discharge at sample time			X	
Fluoride			X	X
Hardness			X	X
Hydroxide (pH dependent)			X	X
Iron			X	X
Lead			X	X
Lithium	X	X		
Magnesium			X	X
Manganese	X	X		X
Mercury			X	X
Molybdenum	X	X		X

[1]Parameters, dropped from original list because they are considered not important in these areas at this time, are: acidity, aluminum, beryllium, cobalt, color, copper, cyanide, nickel, silver, turbidity, and zinc.

Parameter	Annual for Ephemeral streams	Semi-Annual for Perennial streams	Six samples minimum annual for Ephemeral or Perennial streams	Annual for GW sites
Nitrogen, ammonia	X	X		X
Nitrogen, nitrate			X	X
Nitrogen, nitrite	X	X		X
Oxygen, dissolved			X (perennial)	
pH			X	X
Phosphorous (as dissolved PO^4)			X	X
Phosphorous (total)	X	X		X
Potassium			X	X
Phytoplankton		X		
Radioactivity, gross alpha	X	X		X
Radioactivity, gross beta	X	X		X
Radium	X	X		X
Residue at 180° C (dissolved solids)	X	X		X
Selenium			X	X
Silica			X	X
Sodium			X	X
Specific conductance			X	X
Streptococci bacteria, fecal		X		
Strontium	X	X		X
Sulfate			X	X
Sulfide				X
Suspended sediment (total)			X	
Suspended sediment (particle size)	X	X		
Temperature, water			X	X
Uranium	X	X		
Vanadium	X	X		

Note: From this list the project investigator shall select parameters to be measured for a sample and the frequency of measurement at a site. Data will be reviewed as analyses are completed and other parameters may be added if needed. Dissolved and suspended concentrations of many constitutents, particularly trace elements, will be determined. Schedules shown in this table will be followed as closely as possible with consideration given to available samples, sampling time and stage, unusual concentrations, and any other sampling contingencies.

North Dakota

NORTH DAKOTA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA FUNDS
Hydrologic Modeling Wibaux-Beach and Rattlesnake Butte	$ 168,300
Surface-Water Modeling Beulah Trench and Wibaux-Beach	140,500
Ground-Water Investigation McKenzie County	6,800
	$315,600

NORTH DAKOTA

I. Hydrologic Modeling

A. Wibaux-Beach

1. Location and Objectives: The strippable lignite of the Wibaux-Beach deposit is a major aquifer of the area and is in close stratigraphic association with the other aquifers. The deposit area is probably within a region of major recharge to the lower Tongue River and Ludlow aquifers. The probable hydrologic impacts of coal development on these aquifers are not known. Most streams within the study area are ephemeral, but one does flow for most of the year and is the irrigation water source for several adjacent landowners. Mining activities may impact the surface waters in terms of both quantity and quality of streamflow. Also of concern are the geochemical modifications attendant to the mining process and the effects these alterations may impose on the hydrologic system.

The objectives of this investigation are to: (1) define the pre-mining hydrology and geochemical regime within the drainage basins containing the Wibaux-Beach lignite deposit. A historical data base will thus be established to assess any modifications attendant on future coal mining; and (2) develop the capability of projecting the hydrologic ramifications of various land treatments imposed by the mining process.

Strip mining disrupts the zone of interaction between the atmospheric, terrestrial, and subterranean segments of the hydrologic cycle. Programs and instrumentation necessary to determine the flow and quality characteristics and the various modes of exchange of water between the respective segments will be initiated early in the project. The collected data will be used in conjunction with digital models to gain a thorough knowledge of the hydrologic regime. Quantitative hydrologic parameters will be refined and data deficiencies will be identified with the aid of the models. When the models are calibrated and verified against the present hydrologic system, they will be available for estimating the hydrologic ramifications of various land treatments within the study area. A final complete report is planned for April 1980.

2. Relationship to Other Closely Associated Non-EMRIA Funded Activities: The study is finded jointly through EMRIA funds and U.S. Geological Survey Federal funds. The Wibaux-Beach lignite deposit is one of the deposits covered by the hydrologic reconnaissance studies under ND-070F, which was started in FY 75, was scheduled for completion in FY 77, and was funded by the USGS. The portion of the deposit in Golden Valley County is covered by the County Ground-Water Resources Study under ND-069, which was started in 1975 and scheduled for completion in 1978. This study is funded under a cooperative agreement by the USGS, North Dakota State Water Commission, U.S. Park Service, and U.S. Forest Service. These studies, though at a reconnaissance level, result in substantial savings in the present study. The reports are still being processed.

   Data on streamflow, sediment loads, quality of water, and ground-water levels are being collected in the vicinity of the study. These data are being collected through programs with the North Dakota State Water Commission, and with USGS funds. There will be a mutually beneficial exchange of data between the programs.

3. Progress Through 1979: Four continuous-record stream-gaging stations were in operation. All streams in the area were sampled for chemical analysis and sediment concentration during runoff events. Meteorological data were collected at several sites. A start was made in computing basin parameters, and the data are being computer-stored for use in a watershed model which has been developed to the point where real data can be used as input and testing of responses can be made.

   The surface-water modeling effort is being transferred to the project, "Surface-Water Modeling, Beulah Trench and Wibaux Beach," as the current project is scheduled for completion in 1980. It is necessary that data collection continue for sometime yet on the surface-water modeling.

   The first round of drilling was completed in July to August of 1978. Approximately 9,000 ft was drilled and observation wells installed. A second and final phase of drilling was completed in 1979. The observation wells have been developed and are being sampled for chemical analysis. The network should now provide adequate data to develop a digital flow model. Water-level data from the wells will be used in the ground-water modeling effort. A preliminary two-dimensional model has already been formulated and is being used experimentally.

The major emphasis in FY 80 will be an interpretation of the ground-water flow system through the use of the model and an evaluation of the water chemistry in the system.

4. Distribution of Funds:

Salaries	$26,700
Travel	3,900
Contractual Services	
Supplies and Equipment	
Laboratory Costs	2,300
Data Processing, including computer costs	4,600
	$37,500

5. Reports: Basic records for surface-water quantity and surface-water quality stations will be published in the USGS annual series, "Water Resources Data for North Dakota, Water Year 19__," or as an appendix to an interpretive report. Basic records for ground-water quality stations will be available to BLM and other interested parties and as an appendix to the interpretive report. The interpretive report on the hydrologic evaluation of strip mining and reclamation in the Wibaux-Beach area is scheduled for review by April 1980 and will probably be published in the Water Resources Investigation Series of the USGS.

B. Rattlesnake Butte

1. Objectives: In response to the Interior Department's recent call for leasing nominations of Federal coal lands, most eligible tracts within the Dickinson deposit were submitted by mining concerns for consideration of their leasing potential. The interest manifest in the Dickinson field indicates a possibility of future development, of which the Rattlesnake Butte area is a part. This study is an investigation to evaluate the probable hydrologic impacts of that potential development in an area of interest to BLM. Depending on the hydraulic properties and the areal continuity of the lignite and adjacent aquifers, many of these water sources could be diminished or obliterated.

Of particular significance to the city of Dickinson would be the effects on the Heart and Green Rivers. The Heart River is located 1 mi west of Dickinson and serves as the city's water supply reservoir. The Bureau of Reclamation is currently studying the feasibility of creating a water supply reservoir on the Green River, anticipating future shortage.

The primary objectives include assessing the ground-water flow system and its chemical characteristics and determining surface-water flow magnitudes and frequencies, chemical quality, and sediment concentration and load.

By defining the hydrologic regime of the study area, a further objective will be satisfied--establishing a historical data base to monitor changes in the system as mining proceeds. The ultimate objective is to develop the capability of making reasonably accurate projections of the hydrologic effects which result from the various physical treatments imposed by surface mining. Management agencies would then be able to utilize this predictive tool to augment their decision-making processes.

Such operational components of the total hydrologic regime as infiltration and percolation, evapotranspiration, changes in storage in the unsaturated zone, and the various modes of exchange between shallow subsurface and surface-water systems will be quantitatively assessed. This will allow for appropriate perspective placement of each component in the overall system. One of the early project emphases will be Program implementation. Also emphasized will be effecting the instrumentation necessary to quantify all hydrologic cycle segments and pathways and to discern the nature of and the mechanisms operative on its water quality.

Collected data will be used with digital models to gain a thorough knowledge of the hydrologic system. Quantitative hydrologic parameters will be refined and data deficiencies will be identified with the aid of the model. This refine-simulate-refine process will be repeated until the model is calibrated and satisfactorily represents the real system. It will then be available for estimating the hydrologic effects of various land treatments within the study area.

2. Relationship to Other Closely Associated Non-EMRIA Funded Activities: The Dickinson deposit is one of the deposits that will be covered by the hydrologic reconnaissance studies under ND-070F, which was started in FY 75 and is funded by the U.S. Geological Survey. The data collection under ND-070F will be of value to the present study. Since the ultimate objective of ND-070F is to provide an in-depth appraisal of the hydrologic effects of mining for each of the identified strippable deposits, the Rattlesnake Butte study will result in a savings in the eventual overall cost of ND-070F.

   Data on streamflow, sediment loads, quality of water, and ground-water levels are being collected in the study vicinity. These data are being collected through programs with the North Dakota State Water Commission, Environmental Protection Agency, Corps of Engineers, and USGS funds. There will be a mutually beneficial exchange of data between the programs.

3. Progress Through 1979: The first of two drilling phases has been completed. Several 400-ft test holes were drilled and observation wells established to define the shallow aquifers. Two continuous-record stream-gaging stations were operated through the year, and chemical quality and sediment samples were taken. Plans for FY 80 include interpreting the present data base, possibly utilizing a digital model, defining any further data needs, and effecting a final phase of subsurface exploration.

4. Distribution of Funds:

Salaries	$ 63,600
Travel	13,600
Laboratory Costs	7,600
Contractual Services	41,000
Equipment and Supplies	1,800
Data Processing, including computer costs	3,200
	$130,800

5. Reports: Basic records for surface-water quantity and surface-water quality stations will be published in the USGS annual series, "Water Resources Data for North Dakota, Water Year 19__," or as an appendix to an interpretive report. Basic records for ground-water levels and ground-water quality stations will be available to BLM and other interested parties and as an appendix to the interpretive report. The interpretive report on the hydrologic evaluation of the Rattlesnake Butte area is scheduled for review by April 1981 and will probably be published in the Water Resources Investigation series of the USGS.

6. Hydrologic Modeling: Total funding $168,300.

C. Surface-Water Modeling, Beulah Trench and Wibaux-Beach

1. Objectives: This project is a part of two broader scoped studies--"Hydrologic effects of mining and reclamation, Mercer County" and "Hydrologic effects of mining and reclamation, Wibaux-Beach lignite deposit"--which are scheduled to end September 1979 and September 1980, respectively. The modeling of the ground-water system will be complete by these dates, but the modeling of the surface-water system cannot be completed due to the lack of a sufficient data base. The surface-water modeling will need at least 5 years of data.

   Preliminary data indicate that the proposed expansion of strip-mining activities in the Beulah trench area may result in streamflow regimen changes. Although there are currently no mining activities in the Wibaux-Beach study area, coal mining is expected in the future with probable attendant changes. Some changes will be temporary, but others will remain even after strip mining has ceased. The purpose of this investigation is to provide a means for BLM personnel or others to judge the impacts of changing land use. The objectives are to: (1) determine pre-mining hydrologic conditions in small representative drainage basins, (2) provide historical data to compare the magnitude of change with mining, and (3) develop the capability of making reasonably accurate projections of hydrologic effects resulting from the various land treatments imposed by surface mining.

2. Approach: This will be a comprehensive study of two small representative basins. Surface models will be developed through coupling of snowmelt- and rainfall-runoff models. A distribution-parameter approach will be used in the model by having the basin partitioned into subunits based on slope, vegetation type, soil type, snow distribution, and other factors.

3. Relationship to Other Closely Associated Non-EMRIA Funded Activities: The proposed study will be funded jointly through EMRIA funds and USGS Federal funds. The Wibaux-Beach and Beulah trench lignite deposits are two of the deposits covered by the hydrologic reconnaissance studies under ND-070F, which was started in FY 75, was scheduled for completion in FY 77, is in the report stage, and is funded by the USGS.

   Data on streamflow, sediment loads, quality of water, and ground-water levels are being collected in the vicinity of the studies. These data are being collected through programs with the North Dakota State Water Commission and with USGS funds. There will be a mutually beneficial exchange of data between the programs.

4. Distribution of Funds:

Salaries	$115,600
Travel	14,500
Contractual Services	500
Supplies and Equipment	1,000
Laboratory Costs	4,700
Data Processing, including computer costs	4,200
	$140,500

5. Reports: The runoff, chemical quality, and sediment data will be published annually in the series, "Water Resources Data for North Dakota, Water Year 19__." The final report is planned at the end of approximately 5 years of data collection, assuming a sufficient data base will be available to answer the objectives. The report will probably be in the series, "Water-Resources Investigations," or some type of open-file report. The model will be retained on diskettes and/or disk for future use.

   Progress reports will be furnished periodically as needed.

II. Reconnaissance Studies

A. Investigation of the Ground-Water Resources of McKenzie County, North Dakota

1. Objectives: McKenzie County contains large deposits of federally owned lignite and is potentially one of the major lignite-producing counties of the State. Much of the lignite is saturated and in fact is the host rock for aquifers that supply water for domestic and farm use in much of the county. In view of its mining potential and the importance of ground-water supplies to the residents, it is important that ground-water information be obtained prior to mining so that the probable effects of mining may be predicted and so that land reclamation after mining be undertaken to reconstruct the aquifer systems.

   The purpose of this study is to survey and document the quantity, quality, and movement of ground water in McKenzie County. In addition, this study will provide fundamental data and quantitative interpretations on which water-management decisions can be made for municipal, domestic, industrial, and irrigation uses. Specific objectives are to: (1) determine the location, extent, and nature of major aquifers, including estimates of storage and potential yield; (2) evaluate the chemical quality of the ground water; (3) identify current and potential use of ground water; and (4) estimate and attempt to quantify the movement of ground water, including sources of recharge and discharge.

This is a relatively comprehensive study of the ground-water resources. Study methods are categorized by the following activities: (1) project planning, (2) water records, (3) test drilling, (4) chemical quality of water sampling and analyses, (5) aquifer tests and special studies, (6) data compilation and analysis, and (7) report preparation.

2. Relationship to Other Closely Associated Non-EMRIA Funded Activities: This study is jointly funded through EMRIA funds, USGS, U.S. Park Service, North Dakota State Water Commission, and North Dakota Geological Survey.

   There are no other funded projects in the county at this time.

3. Progress Through 1979: A well inventory of the county was essentially completed with selected water samples obtained for chemical analysis. One Fox Hills well was drilled to fill a data gap in a cross section across the county. Available data were analyzed to establish a drilling program to fill in gaps. Drilling is planned for early 1980 with a subsequent data reevaluation.

4. Distribution of Funds:

Salaries	$5,800
Travel	1,000
	$6,800

5. Reports: Three reports will be published cooperatively by the North Dakota State Water Commission and the North Dakota Geological Survey. Part I will describe the surface geology; Part II will be a compilation of basic data, including data on existing wells and test holes; and Part III will be an interpretative report describing and evaluating the ground-water resources of the county.

NORTH DAKOTA

LIST OF WATER QUALITY PARAMETERS

Hydrologic Studies

Field

Discharge (ft^3/s)	SW only
Temperature (°C)	
pH	
Specific conductance	

Laboratory

Alkalinity (Tot as $CaCO_3$)	
Boron, Diss	
Calcium, Diss	
Chloride, Diss	
Fluoride, Diss	
Hardness, Noncarb	
Hardness, Total	
Iron, Diss	
Magnesium, Diss	
Manganese, Diss	
Molybdenum, Diss	
Nitrogen, Diss KJD	SW only
Potassium, Diss	
Residue, Calc Sum	
Residue, Diss Ton/Aft	SW only
Residue, Diss Ton/Day	SW only
SAR	
Silica, Diss	
Sodium, Diss	
Sodium, Percent	
Strontium, Diss	
Sulphate, Diss	
Susp. Sed. Conc.	

Oklahoma

OKLAHOMA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA FUNDS
Hydrologic Investigations - Blocker Area	$ 49,000
Hydrologic Investigations - Rock Island Area	30,900
Hydrologic Investigations - Red Oak Area	42,900
Hydrologic Investigations - Stigler Area	46,000
Sediment Studies - 12 sites	87,800
Watershed Characteristics	15,000
Hydrologic Model - Coal Creek near Lehigh	100,700
	$372,300

OKLAHOMA

I. Introduction

Purpose and Scope: BLM is responsible for assessing the probable water resources impacts and reclamation capabilities of any area under Federal jurisdiction in which surface coal mining might occur. To meet this responsibility, a variety of hydrologic data are required. In Oklahoma, these areas are being provided by: (1) hydrologic monitoring in selected areas, and (2) hydrologic modeling of Coal Creek basin near Lehigh. In addition, hydrologic data are also being generated by the Survey's monitoring program at 12 sites in the coal field and sediment data collection at these 12 sites under the auspices of the BLM.

Areas near Blocker, Rock Island, Red Oak, and Stigler have been identified as having high potential for mining of Federal coal. Hydrologic data collection in the Blocker and Rock Island areas began in 1976 and in the Red Oak and Stigler areas in 1978.

BLM has contracted for overburden test drilling in the Blocker, Rock Island, Red Oak, Stigler, and Spiro areas; drilling should be completed by the end of August 1979. Geophysical logs (resistivity, conductivity, gamma, and caliper) of each test hole are being made by the Survey. In addition, 1 test hole in each of the 5 areas will be completed as an observation well.

II. Hydrologic Investigations

A. Blocker Area:

1. Blue Creek near Blocker.

   a. Continue surface water gaging station.

   b. Collect samples as scheduled.

2. Blue Creek tributary near Blocker.

   Make instantaneous discharge measurement at time samples are collected.

3. Mathuldy Creek near Crowder.

   Make instantaneous discharge measurement at time samples are collected.

4. Maintain ground-water level recorder near Blocker; install water-level recorder in test hole when it has been completed.

5. Maintain rain gage near Blocker.

6. Sample frequency.

   a. Monthly - common constituents and nutrients.

   b. Semi-monthly - field parameters, dissolved and total metals, and sediment.

   c. Semi-annually - bottom materials.

7. Suites of analyses - see Attachment A.

8. Reports.

   a. Streamflow, stream water quality, and sediment data will be published in the annual data report.

   b. Complete report on the hydrology of the Blocker area including all basic data collected as of September 30, 1979. The report draft will be delivered to Denver Service Center EMRIA staff by July 30, 1980.

B. Rock Island Area:

1. James Fork near Hackett, AR.

   Collect samples as scheduled.

2. James Fork near Williams.

   Make instantaneous discharge measurement at time samples are collected.

3. Install ground-water level recorder on test hole when it has been completed to replace discontinued recorder site near Williams.

4. Relocate temporarily discontinued rain gage to site of new observation well.

5. Sample frequency and suites of analyses - same as for Blocker area.

6. Reports.

   a. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

   b. Complete report on the hydrology of the Rock Island area including all basic data collected as of September 30, 1979. The report draft will be delivered to Denver Service Center EMRIA staff by July 30, 1980.

C. Red Oak Area:

1. Brazil Creek near Walls below mining area.

   a. Continue surface-water gaging station.

   b. Collect samples as scheduled.

2. Brazil Creek near Red Oak above mining area.

   Make instantaneous discharge measurement at time samples are collected.

3. Rock Creek near Red Oak above mining area.

   Make instantaneous discharge measurement at time samples are collected.

4. Collect 10 ground-water samples for laboratory analysis.

5. Install and maintain ground-water level recorder in test hole when it has been completed.

6. Maintain rain gage.

7. Sample frequency and suites of analyses - same as for Blocker area.

8. Reports.

   a. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

   b. Start report on the hydrology of the Red Oak area.

D. Stigler Area:

1. Taloka Creek near Stigler below mining area.

   a. Continue surface-water gaging station.

   b. Collect samples as scheduled.

2. Taloka Creek near Stigler above mining area.

   Make instantaneous discharge measurement at time samples are collected.

3. Collect 10 ground-water samples for laboratory analysis.

4. Install and maintain ground-water level recorder in test hole when it has been completed.

5. Maintain rain gage.

6. Sample frequency and suites of analysis - same as for Blocker area.

7. Reports

   a. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

   b. Start report on the hydrology of the Stigler area.

III. Sediment Studies

Sediment samples will continue to be collected at each of the sites listed below. They are operated under the USGS Coal Hydrology Monitoring Program. Samples are collected once daily by observers at Muddy Boggy River at Atoka and at Caston Creek at Wister; the other sites are sampled automatically by PS-69 samplers.

A. Brushy Creek near Haileyville

B. Caston Creek at Wister

C. Coal Creek near Spiro

D. Deer Creek near McAlester

E. Fourche Maline near Wilburton

F. Holi-Tuska Creek near Panama

G. Morris Creek at Howe

H. Muddy Boggy River at Atoka

I. Owl Creek near McCurtain

J. Peaceable Creek near Haileyville

K. Red Oak Creek near Red Oak

L. Sugarloaf Creek near Monroe

IV. Watershed Characteristics:

A. Complete hydrologic analysis and prepare report on Pecan Creek basin.

B. Install rain gages in a basin to be selected.

V. Hydrologic Modeling - Coal Creek Basin near Lehigh, Oklahoma

A. Surface-Water Flow Regime:

1. Coal Creek.

a. Continue surface-water gaging station.

b. Continue crest stage gage.

2. Coal Creek tributaries.

a. Continue crest stage gages.

b. Make periodic discharge measurements.

B. Stream Water Quality:

1. Coal Creek.

a. Continue water-quality monitor for pH, specific conductance, dissolved oxygen, and temperature.

b. Continue automatic water sampler to collect suspended sediment samples daily and during selected runoff events.

c. Continue monthly water sample collection, and during selected runoff events, for analysis of common constituents and nutrients.

d. Collect approximately 25 water samples, divided between runoff events and baseflow, for metals analysis.

e. Collect water samples quarterly for organic carbon analysis.

2. Coal Creek tributaries.

a. Continue single-stage sediment samplers.

b. Continue water samples collection quarterly to determine field parameters, common constituents, nutrients, metals, and organic carbon.

C. Ground-Water Regime:

1. Continue ground-water level recorder.

2. Make annual mass measurement of all accessible wells in the basin and selected wells outside the basin.

D. Climatological Data

1. Continue operating continuous climatological station to determine air temperature, relative humidity, solar radiation, precipitation, and wind speed and direction.

2. Continue operation of 3 continuous precipitation gages.

3. Continue periodic soil moisture measurement at 12 sites.

E. Preliminary Modeling

Make preliminary model calibration with respect to rainfall-runoff, sediment transport and other parameters, if feasible.

F. Reports

1. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

2. Prepare report including all basic data collection as of September 30, 1979.

3. Start hydrology of Coal Creek basin report.

4. If warranted, start report on preliminary model calibration results.

ATTACHMENT A

Analytical Suites

Field Parameters

00400	pH
00095	Specific conductance
00010	Water temperature
00300	Dissolved oxygen
	Instantaneous water discharge

Common Constituents -- DISSOLVED

00955	Silica
00915	Calcium
00925	Magnesium
00930	Sodium
00935	Potassium
00410	Alkalinity
00940	Chloride
00945	Sulfate
00950	Fluoride
70300	ROE at 180° C
00800	Color
00076	Turbidity

Nutrients

	Dissolved	Total
Nitrogen, Kjeldahl	00623	00625
$NO_3 + NO_2$	00631	00630
Phosphorous	00666	00665

Metals

	Dissolved	Total
Aluminum	01106	00105
Arsenic	01000	01002
Boron	01020	01022
Cadmium	01025	01027
Chromium	01030	01034
Copper	01040	01042
Iron	01046	01045
Lead	01049	01051
Manganese	01056	01055
Mercury	71890	71900
Molybdenum	01060	01062
Zinc	01090	01092

Calculated Values

Sodium adsorption ratio (SAR)
Total hardness
Dissolved solids tons/acre feet

Bottom Materials

00626	Nitrogen, Kjeldahl
00633	$NO_3 + NO_2$
00668	Phosphorous
01108	Aluminum
01003	Arsenic
01028	Cadmium
01034	Chromium
01043	Copper
01170	Iron
01052	Lead
01053	Manganese
71921	Mercury
01063	Molybdenum
01093	Zinc

Utah

UTAH

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA	OTHER
Hydrology of Ferron Sandstone in Castle Valley	$114,500	
Hydrology Study, Uinta Basin		$13,000
Hydrology, Central Wasatch Plateau (UT-930-4110-1125) (State EMRIA Funds)	$114,500	
Cooperative State Programs (UT 1, 3, and 4)		$54,730
Hydrology, Price River Basin		$114,500
	$229,000	$182,230

State of Utah: $411,230

UTAH

I. Hydrology of Ferron Sandstone in Castle Valley and Effects of Strip Mining near Emery, Utah

A. Location: Southern Castle Valley in east-central Utah, total area about 800 sq mi.

B. Objectives:

1. Determine effects of stripping upper confining shale layers from Ferron Sandstone aquifer and mine dewatering on:

a. Existing wells and springs,

b. Base flow and quality of water in streams,

c. Quality of water in Ferron Sandstone, and

d. Rates and directions of leakage between aquifer and its confining layers.

2. Determine effects of erosion and leaching of stockpiled overburden on the sediment, water quality, and its confining layers.

3. Determine recharge and discharge, aquifer characteristics, and quantity and quality of water available from Ferron Sandstone throughout Castle Valley.

C. Approach: During FY 1980 will consist of:

1. Continued literature survey and file search for previous studies done and hydrologic data collected in and near the study area and for studies in other areas which have relevant results.

2. Continued contact with coal, oil, gas, and seismic companies and Federal and State agencies to obtain drilling and hydrologic data.

3. Inventory of springs and seepage measurements along streams that cross the Ferron Sandstone outcrop.

4. Continued streamflow, quality-of-water, precipitation, and water-level data collection.

5. Aquifer testing to define the quantity and quality of water in the Blue Gate, the coal-bearing and lower marine-sandstone sections of the Ferron, and the degree of interconnection between zones.

6. Continued design and verification of Ferron Sandstone digital model.

7. Report preparation and review.

D. Reports: An interpretive data report will be prepared by October 1980.

E. Distribution of Funds (FY 1980):
(Salaries are included in individual items and total about $42,000).

Data Collection	$ 20,000
Lab Support	3,000
Computer Services	5,000
Aquifer Testing and Well Construction	5,000
Travel and Per Diem	2,000
Report Preparation and Review	43,400
District Overhead	20,600
WOTSC	15,500
	$114,500

II. Hydrologic Study of Uinta Basin, Utah

A. Location: Southeastern Uinta Basin, about 2,400 sq mi

B. Objective: To collect streamflow and sediment data in FY 1980. To continue depending on annual appropriations.

C. Approach:

1. Operate streamflow gaging station at 1 site:

09306900 White River at mouth near Ouray, Utah, in SE1/4SE1/4 NW1/4 Sec. 2, T9S, R20E, Uintah County, Lat. 40°03'54", Long. 109°38'06".

2. Collect daily sediment samples at gaging site shown under item 1 and calculate daily suspended-sediment loads.

D. Reports: Information will be included in normal basic data Utah District reports. BLM may request data directly if needed.

E. Budget Distribution of Funds:

Salaries	$ 3,355
Sediment Observer	1,000
Travel and Transportation	1,280
Supplies and Equipment	130
Laboratory Support	2,500
Data Processing and Reporting	640
District Overhead	2,340
WOTSC	1,755
	$13,000

III. Hydrology of the Central Wasatch Plateau, Sanpete, Sevier, and Emery Counties, Utah (UT-930-4110-1125)

A. Location: Central Wasatch Plateau, between Cottonwood Creek and IH-70, an area of about 600 square miles.

B. Objectives:

1. Define the extent of aquifers, areas of recharge and discharge, and the quantities and quality of water in storage.

2. Determine the variability in quantity and quality of streamflow and stream biology.

3. Estimate volumes of runoff and flood-prone areas within areas of development.

4. Determine sources of current and potential water supply.

5. Predict, within constraints of available data, effects of coal mining on the water resources and stream biology.

C. Approach: During FY 80 will consist of:

1. Literature and file search to locate all available data and studies.

2. Well and spring inventory, including sampling for chemical analysis.

3. Complete and test exploration holes drilled by Federal and State agencies and by coal and petroleum companies. This will furnish data on water levels, hydraulic properties, and water quality in an adjacent to the coal-bearing zones.

4. Conduct seepage runs on streams and aquifer tests on existing wells.

5. Sample surface water for chemical analysis and sediment and make an aquatic-biota survey.

6. Install rain gages to collect precipitation data to use in correlating rainfall and runoff. Delineate areas, within coal-development areas, that will be inundated by floods of various recurrence intervals.

7. Study the occurrence of water in existing underground coal mines.

D. Reports: A final interpretive report will be prepared by September 1981.

E. Distribution of Funds: (Salaries are included in individual items and total about $55,000).

Planning	$ 10,000
Data Collection	35,000
Central Laboratory	7,000
District Sediment Laboratory	4,500
Computer Time	1,900
Well-Completion and Aquifer-Testing Equipment	8,500
Travel and Per Diem	8,000
Report Preparation and Review	19,000
District Support	20,600
	$114,500

IV. Cooperative State Program UT 1, 3 and 4.

A. Objective: To determine the sediment, salinity and discharge of water resources in the San Rafael River, Muddy River, and Sevier River drainages and the Pariette Wash area, in Emery, Wayne, Sevier, and Uintah Counties, respectively, Utah.

B. Approach: Provide for the operation and maintenance of sediment, water quality, and gaging station operations on the following waters during FY 80 as listed below:

UT-1 Collection of basic records, surface water

Muddy Creek at State Highway 24, near Hanksville	$ 3,370
Ferron Creek near mouth, near Clawson	3,370
Muddy Creek, 3 miles above Salt Wash	3,370
San Rafael River, at S.R. campground, near Castle Dale	3,370
Pariette Draw below Pleasant Valley Wash, near Myton	3,370
Pariette Draw at mouth, near Ouray	3,370
Lamb Diversion, at Pariette Draw, near mouth	3,370
Cottonwood Creek near Orangeville	3,370
Otter Creek at Koosharem	3,370
	$30,330

UT-3 and 4 Collection of basic records, chemical quality and sediment

Muddy Creek at State Highway 24, near Hanksville	$ 3,050
Ferron Creek, near mouth, near Clawson	3,050
Muddy Creek, 3 miles above Salt Wash	3,050
San Rafael River, at S.R. campground, near Castle Dale	3,050
Pariette Draw, below Pleasant Valley Wash, near Myton	3,050
Pariette Draw, 5 miles above mouth	3,050
Pariette Draw at mouth, near Ouray	3,050
Cottonwood Creek near Orangeville	3,050
	$24,400

C. Distribution of Funds: Appropriation Code 4340-5273.

V. Hydrology of the Price River Basin, with Emphasis on Areas Underlain by Coal.

A. Location: Price River drainage basin, approximately 1,500 square miles, with most emphasis in the areas of the basin underlain by coal in the Book Cliffs and Wasatch Plateau in Carbon, Emery, Utah, Wasatch, Sanpete, and Duchesne Counties.

B. Objective: To determine the effects of present and proposed coal mining on the hydrology of the Price River Basin. Specifically to determine the effects of coal mining (including the effects of existing and potential land subsidence) on surface-water quantity, quality, and biology; ground-water recharge, movement, discharge, and quality; and sediment yields.

C. Approach: During FY 1980 will consist of:

1. Literature survey and search of the files of Federal and State agencies to compile data previously collected in the area that will be useful in this study.
2. Contacting coal and oil companies to obtain drilling data and available hydrologic data, including data on the occurrence of water in existing coal mines.
3. Inventory of wells and springs and sample collection of surface and ground water for chemical analysis.
4. Determining water-bearing zones in the stratigraphic section using information obtained in (1), (2), and (3).
5. Making seepage measurements along streams to indicate reaches gaining water from or losing water to the ground-water reservoir.
6. Designing a data-collection network to supplement present and past sites for collection of surface-water, ground-water sediment, water-quality, and precipitation data.
7. Determining the need for test-drilling to obtain ground-water data; and if deemed necessary, design a drilling and testing program and prepare specifications for a contract.
8. Drilling test holes for aquifer testing.
9. Conducting aquifer tests on existing wells to determine hydraulic characteristics of aquifers.

D. Reports: A basic-data report and an interpretive report will be prepared by September 1981.

E. Distribution of Funds:

Salaries	$ 65,000
Travel and Transportation	7,500
Laboratory Support	7,000
Supplies	5,500
Computer Services	3,000
Test Drilling	5,900
District Overhead	20,600
	$114,500

Wyoming

WYOMING

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	EMRIA FUNDS	OTHER
HYDROLOGIC MONITORING		
Surface-Water-Network		
Powder River Basin	$ 8,750	
Green River, Great Divide and Bear River Basins	$ 96,720	
Hanna Basin	$ 26,250	
Other Basins	$ 53,980	
	$185,700	
Precipitation, Infiltration, and Runoff Relations - Small Basins	$ 50,000	
Quality of Runoff from Plains Areas	$ 53,000	
Streamflow Characteristics	$ 85,000	
Erosion and Sedimentation Characteristics		
Movement and Fate of Combustion By-products in Ground Water		
O&M Ryckman Creek Gaging Station		$10,000
	$373,700	$10,000

State of Wyoming: $383,700

WYOMING

I. Hydrologic Monitoring-Surface-Water Network

A. Powder River Basin:

1. Location: Powder River Basin in northeastern Wyoming.

2. Objectives:

a. Determine runoff characteristics for watersheds in or near areas of extensive coal deposits.

b. Determine the physical effects of coal mining and land reclamation on surface runoff and ground-water recharge.

c. Determine the chemical and biologic quality of surface water and sediment transport in streams.

3. Procedures:

a. Operate the stream gage listed below. Approximately 19 additional stations supporting this activity will be operated and funded under the USGS Coal Hydrology Program.

Station Number and Name	SW	GW	Sed.	Total
06365300				
Dry Fork Cheyenne River near Bill, Wyo.	$4,070	$4,000	$ 680	$8,750
TOTALS	$4,070	$4,000	$ 680	$8,750

b. Analyze sediment samples from beds and walls of selected ephemeral stream channels for immediate information on transport characteristics of previously unsampled streams.

4. Report Procedures: Publish basic data in annual report of USGS. Use the data in preparing interpretive reports.

B. Green River, Great Divide, and Bear River Basins:

1. Location: Green River, Great Divide, and Bear River Basins of Wyoming.

2. Objectives:

a. Determination of runoff characteristics for watersheds in or near areas of extensive deposits of coal and oil shale.

b. Determination of the physical effects of coal mining, land reclamation, and in situ oil shale reporting on surface runoff and ground-water recharge.

c. Determination of the chemical and biologic quality of surface water and sediment transport in streams.

3. Procedures:

a. Operate the stream gages listed below. The water-quality data will be examined to see if more useful information can be obtained by installing continuous monitors at a few selected stations. If this change in procedure is feasible, the monitors will be installed and sampling will be discontinued at all sites except those with monitors.

Station Number and Name	SW	QW	Sed.	Total
09214500 Little Sandy Creek above Eden	$4,070	$2,040	$1,090	$ 7,200
09216527 Separation Creek near Riner	4,070	5,190	4,020	13,280
09216562 Bitter Creek above Salt Wells Creek, near Salt Wells	4,070	5,180	1,240	10,490
09216565 Salt Wells Creek near South Baxter	4,070	5,190	4,020	13,280
09216750 Salt Wells Creek near Salt Wells	4,070	5,180	1,240	10,490
09222300 Little Muddy Creek near Glencoe	4,070	5,190	1,240	10,500
09222400 Muddy Creek near Hampton	4,070	5,180	1,240	10,490
09235300 Vermillion Creek near Hiawatha	4,070	5,190	1,240	10,500
10027000 Twin Creek at Sage	4,070	5,180	1,240	10,490
TOTALS	$36,360	$43,520	$16,570	$96,720

b. Analyze sediment samples from beds and walls of selected ephemeral stream channels for immediate information on transport characteristics of previously unsampled streams.

4. Report Products: Publish basic data in annual reports of USGS. Use the data in preparing interpretive reports.

C. Hanna Basin:

1. Location: Hanna Basin in south-central Wyoming.

2. Objectives:

a. Determine runoff characteristics for watersheds in or near areas of extensive coal deposits.

b. Determine the physical effects of coal mining and land reclamation of surface runoff and ground-water recharge.

c. Determine chemical and biological quality of surface and ground water and sediment transport in streams.

3. Procedures:

a. Operate the stream gages listed below:

Station Number and Name	SW	QW	Sed.	Total
06630300				
Big Ditch near Coyote Springs	$4,070	$4,000	$ 680	$ 8,750
06630330				
North Ditch near Coyote Springs	4,070	4,000	680	8,750
06634990				
Hanna Draw near Hanna	4,070	4,000	680	8,750
TOTALS	$12,210	$12,000	$2,040	$26,250

b. Analyze sediment samples from beds and walls of selected ephemeral stream channels for immediate information on transport characteristics of previously unsampled streams.

4. Report Products: Analyze data and prepare progress reports as significant data become available. Publish basic data in annual reports of USGS. Use the data in preparing interpretive reports.

D. Other Basins:

1. Location: Big Horn and North Platte Basins.

2. Objectives:

a. Determine runoff characteristics for watersheds in or near areas of extensive coal deposits.

b. Determine the physical effects of land use on surface runoff and ground-water recharge.

c. Determine the chemical and biologic quality of surface and ground water and sediment transport in streams.

3. Procedure:

Operate the stream gages listed below:

Station Number and Name	SW	QW	Sed.	Total
06207510 Big Sand Coulee at Wyoming-Montana State Line	$ 2,730	$ 710	$ 5,390	$ 8,830
06256900 Dry Creek near Bonneville	4,070	920	3,780	8,770
06267400 East Fork Nowater Creek near Colter		1,080	7,530	8,610
06267900 Middle Fork Fifteenmile Creek near Worland		1,080	1,510	2,590
06268500 Fifteenmile Creek near Worland	4,070	1,080	10,270	15,420
06278000 Dry Creek near Greybull	4,070	1,170		5,240
06628800 Sage Creek near Saratoga	2,730	1,050	740	4,520
TOTALS	$17,670	$7,090	$29,220	$53,980

4. Report Products: Publish basic data in annual reports of USGS. Use the data in preparing interpretive reports funded from other sources.

E. Hydrologic Monitoring: Total Funding $185,700.

II. Precipitation, infiltration, and runoff relations for small basins in Wyoming.

A. Location: Wyoming, statewide.

B. Objectives: Federal regulations regarding surface coal mining and reclamation specify that precipitation-frequency criteria be used for hydraulic design. Very little data are available to define the precipitation-runoff relation. This project is designed to develop methods for accurately estimating runoff volumes from small drainage basins for selected precipitation frequencies. Specifically, the objective is to define infiltration-rate curves for soil and other surficial material by an incipient-ponding-curve method developed by Craig and Rankl (USGS).

C. Procedure: This incipient-ponding-curve will be expanded to cover a number of additional basins with differing soil characteristics so that the infiltration model will have wide transferability throughout Wyoming.

D. Report Products: The final report, which will be prepared in FY 82, will describe the methods, soil types, and the ponding equations. It will be published in the Water-Resources Investigation Series.

E. Distribution of Funds:

Salaries	$ 35,500
Travel	4,000
Computer	3,500
Equipment	7,000
	$ 50,000

III. Quality of runoff from small basins in plains areas of Wyoming.

A. Location: Wyoming, statewide.

B. Objectives: Most energy-mineral development in Wyoming is planned for plains areas characterized by ephemeral and intermittent streams. Because of the flashy nature of precipitation and streamflow in these areas, water quality is highly variable and difficult to measure or predict. As a result of this variability, monthly water-quality data do not adequately describe baseline conditions against which future conditions may be compared. More importantly, without adequate knowledge of sources and processes involved in the transport of dissolved and absorbed constituents within the basin, little can be said about expected impacts on water quality resulting from proposed development. Time allowed for data collection and interpretation is not sufficient to develop the desired functional relations by routine, monthly monitoring.

Specific objectives are to: (1) identify dominant processes involved in the divestment and transport of constituents (such as salinity, nutrients, and trace elements) by intermittent and ephemeral streams, and (2) document short-term data collection methods and interpretation used so they may be applied to similar, unstudied basins.

C. Procedure: Existing data collected from two small plains areas in southwestern Wyoming would be analyzed along with data to be collected intensively during runoff events. Relation developed by this study would tentatively include wash-off coefficients (similar to those currently used in urban stormwater modeling), source of and variation in composition of constituents in runoff, and accumulation rates of constituents on basin surfaces.

D. Report Products: The final report, which will be prepared during FY-81, will include the processes identified and all short-term data collection and interpretation methods used.

E. Distribution of Funds:

Salaries	$ 46,000
Travel	3,000
Equipment	3,000
Data Processing	1,000
	$ 53,000

IV. Streamflow characteristics of energy-mineral areas in Wyoming.

A. Location: Wyoming, statewide.

B. Objectives: Information relative to streamflow in the energy areas of Wyoming is inadequate for proper planning, designing, and monitoring of the effects of energy-resource development. Data for developing predictive techniques have been particularly scarce for small intermittent and ephemeral basins. Yet, most existing or proposed mines in Wyoming occur in small basins that have only intermittent or ephemeral streams.

Objectives are to provide techniques that will allow accurate estimates of monthly and annual runoff characteristics for streams in the energy areas, with emphasis on intermittent and ephemeral basins.

C. Procedures: The approach will essentially be an extension of work done by Lowham (USGS) and by Craig and Rankl (USGS), both of which used data available through 1973. Considerable new data are now available. A regional analysis will be made based on average records, and a time-series analysis will be made of monthly and annual runoff to define time distribution. Channel-geometry methods will be reviewed to determine ways to improve these techniques, which should be highly transferable throughout the energy areas. Special emphasis will be placed on coal outcrop and adjacent areas.

D. Report Products: The final report, which will be prepared during FY 81, will summarize data and techniques as well as describe transferability of both.

E. Distribution of Funds:

Salaries	$ 44,500
Travel	3,500
Equipment	4,000
Computer	3,000
Contract (weather data)	30,000
	$ 85,000

V. O&M of One New Gaging Station:

A. Location: Black's Fork Subbasin, Ryckman Creek Watershed. Section 8, T. 18 N., R. 117 W.

B. Data Collection:

1. Site selection and setup should be in May 1980 and operation should last for 5 years.

2. Type and Frequency

a. Discharge: daily.

b. Quality: field determinations, total dissolved solids, and suspended sediment - monthly.
Cation/anion analysis - quarterly.
Trace metals - quarterly.

C. Funding: Non-EMRIA.

1. Charge against WY49PPO-4, activity code 4110-1039.

2. FY 80 - $10,000.

Central Region

Office of Public Land Hydrology

PUBLIC LANDS HYDROLOGY PROGRAM

I. Hydrologic Modeling

A. Location: Wibaux-Beach Basin and Beulah Trench Basin, North Dakota; Prairie Dog Creek Basin, Montana; Kimbeto area, New Mexico; Coal Creek Basin, Oklahoma; and Yellow Creek and Bear Creek Basins, Alabama.

B. Objectives: To collect soil-moisture data to test model parameters of soil-moisture storage and movement, infiltration, and water use by vegetation.

C. Approach: In FY 1980, the Public Lands Hydrology Program (PLHP) will continue to coordinate its work with the hydrologic modeling activities of the Water Resources Division in North Dakota, Montana, New Mexico, Oklahoma, and Alabama. PLHP will collect additional soil-moisture data in the Wibaux-Beach Basin and Beulah Trench Basin, North Dakota, to determine the effects of cultivated land on soil-moisture use and the reclamation of a potential mine site.

Sites in all Districts where neutron-moisture meter access holes are established have been characterized with soil-moisture samples. We will assist these Districts in interpreting soil-moisture data with respect to water movement and storage and the forces required to remove soil moisture from storage. The effect of retention forces on plant growth will be determined at all sites. A computer program will be developed to assist the Districts and BLM in using neutron-moisture meter data in conjunction with data from soil samples.

D. Reports: An interpretive report on the data on soil-moisture characteristics and vegetation responses will be made available to the Bureau of Land Management and Water Resources Division Districts for Oklahoma, April 1, 1980; New Mexico, May 1, 1980; and Montana, September 1, 1980. An open-file report on the collection and interpretation of soil moisture and vegetation data applicable to all sites will be prepared by March 1, 1980.

II. Reconnaissance Studies

A. Location: Prairie Dog Creek Basin, Montana, and Coal Creek Basin, Oklahoma.

B. Objectives: Representative long-term sediment yield data from upland source areas and their relation to vegetation and soil characteristics are useful in defining premining baseline conditions and delineating hydrologic response units for storm-event modeling.

C. Approach: Reservoir sediment surveys in small upland basins will be made in Prairie Dog Creek Basin, Montana, to acquire sediment-yield data under existing land-use practices.

D. Reports: A report will be prepared by PLHP for the Coal Creek Basin, Oklahoma, by April 1, 1980. A report on Prairie Dog Creek Basin, Montana, will be proposed by September 15, 1980. These reports intended for publication in the Geological Survey Water Resources Investigations series will include the following:

1. Vegetation and soils map together with interpretations to show premining conditions and postmining potential for reclamation.
2. Representative sediment yields from small upland basins.
3. Infiltration rates, overland flow, and sediment-yield data from rainfall-simulator experimental runs.
4. The report narrative will discuss plant species that would naturally succeed on a site following land disturbance and recommendations for practices that can optimize soil moisture use.

III. Distribution of Funds:

Salaries, professional, and technical assistance (field, office, and laboratory)	$ 90,356
Travel	5,150
Vehicles	2,500
Supplies and equipment	1,000
Data processing and computer costs	2,700
	$101,706
WOTSC	15,999
Administrative Service Charge	3,145
Total	$120,850

IV. Rainfall-Simulation ( ):

A. Work to be Performed: During FY 1980, rainfall-simulation investigations by the Geological Survey will be concentrated on the establishment and operation of a small study watershed. The small watershed is to be equipped with semipermanent instrumentation for collection of data on natural events as well as standard simulated events. The data obtained from rainfall-simulation plots will be used in conjunction with data from the larger watershed, which will be obtained by the Rainfall-Runoff Modeling Group of the Geological Survey.

Specific objectives to be addressed are:

1. To develop instrumentation for determining values of variables and parameters in the Green-Ampt equation and the spatial variability of these values within the simulator plots. This will involve measuring the progress of the wetting front at numerous locations within the plot as well as measuring the soil-moisture content at selected sites.

2. To determine means of relating these variables and parameters to measureable physical properties of the plots.

3. To determine the effects of rainfall intensity on sediment yield and infiltration. This will involve development of the capability to vary the application rate of rainfall with the presently operated simulator.

4. To determine the equivalence of natural and simulated events and the transferability of data from small plots to larger watersheds using rainfall-runoff models.

B. Reports: A verbal report will be made to the Bureau just prior to the start of the field season to alert the COAR that fieldwork is about to begin.

A summary of data collected at the Coal Creek, Oklahoma, EMRIA study watershed will be included in the EMRIA site report being prepared by other Geological Survey personnel.

A report will be prepared at the end of the 1980 field season outlining progress during the year and including a summary of data obtained during the 1979 field season.

C. Distribution of Funds:

Salaries, professional and technical	$24,000
Travel	3,000
Vehicles	2,225
Supplies and equipment	0
Data processing and computer costs	0
Subtotals	$29,225
WOTSC	4,725
Administrative services charge	1,050
SLUC	0
Totals	$35,000

Channel Geometry

STREAMFLOW CHARACTERISTICS RELATED TO CHANNEL GEOMETRY OF STREAMS IN COAL LEASE AREAS

Estimates of streamflow characteristics are presently required for hydrologic studies and assessing the impact of coal mining in central and western United States. In the regions where it is difficult to relate streamflow characteristics to precipitation, drainage area, and other measurable basin characteristics, additional methods are needed. Channel geometry is one such method. Streamflow characteristics have been related to channel geometry of streams in much of western United States through many individual studies, mostly statewide. Results of the studies, as indicated by standard errors of estimate, have been good for the most perennial streams and excellent for perennial mountain streams. These relations probably can be transferred to other areas, but some verification in each area will be necessary to assure this. Results are generally unknown for ephemeral streams because most study areas had too few long-term ephemeral gaging stations to develop reliable relations. Relations of the streamflow characteristics to channel geometry of ephemeral streams will need to be developed using available gaging stations data in western United States.

The principal objectives of the proposed study would be directed specifically to the strippable coal areas in central and western United States and are: (1) to verify the transferability of the existing relations of streamflow characteristics to measurable dimensions of channel geometry and channel material characteristics of perennial streams; (2) to develop new relations of streamflow characteristics to measurable dimensions of channel geometry and channel material characteristics of ephemeral streams; and (3) to investigate the feasibility of estimating sediment transport characteristics for perennial and ephemeral streams.

The following approach is to be used: Data should be collected at gaging stations with 20 or more years of record on perennial streams in or near the major coal areas to verify existing relations that have been developed from the two Missouri River basin studies or other statewide studies. Existing relations could then be used directly or with adjustments if necessary. The width and average depth of the channel cross section for the active channel and the bankfull stage should be measured. Bed- and bank-material samples should be collected for particle-size analysis. A measurement of channel slope should be included. At all sites additional data that may prove pertinent, such as channelization, vegetation, presence of bedrock, and evidence of recent flooding should be collected.

Information sufficient to develop statistically significant regression equations should be collected from suitable ephemeral sites throughout

the western United States. Several studies should be made, aimed primarily at developing methods for estimating the flow characteristics at ungaged sites. Measurements should be made of the dimensions of channel geometry that have proved successful in other studies, i.e., width and average depth of the channel cross section between in-channel depositional bars, the active channel, and the bankfull stage. Data collection should include sampling and particle-size analyses of bed and bank material in order to adjust the discharge-geometry relations depending on the size characteristics of the channel alluvium. This technique has been used successfully for perennial streams of Kansas and the Missouri River basin and is presumed applicable to ephemeral channels as well. A measurement of the channel slope should be included. Consideration also should be given to the possible influence of varying communities and densities of riparian vegetation. One to three cross sections should be measured at each selected site. Sites should be selected at or near gaging stations with continuous record for 20 or more years. The data should be collected by hydrologists that have had experience in channel geometry. One or more representatives from each USGS District or BLM Office could participate in the field work. The plan will save time in locating the gaging station and a good reach of channel and provide excellent training.

Suspended-sediment data, reservoir and stock-pond surveys, and other established methods of evaluating sediment movement in arid and semi-arid climates should be compiled. These data should be correlated with channel-geometry and channel-material information to determine if methods for estimating sediment discharge can be developed.

REPORT PLANS

The results will be open-filed and duplicated for early availability as soon as practicable after the end of the second year of the 2-year study. The final results of the study will be reported in the Water Supply Paper series.

COST ESTIMATES

	FY 80
Data Collection	$ 53,300
Travel	8,000
Laboratory Analyses	8,000
Data Analyses	18,700
Report Preparation	5,300
Support to other Districts	6,700
Total	$100,000

BRANCH of COAL RESOURCES

ANNUAL WORK PLAN

October 1, 1979 through September 30, 1980

The General Agreement between the Bureau of Land Management (BLM) and the Geological Survey (GS), dated August 1974, is considered an integral part of the Work Plan.

Purpose and Scope of Program

I. Assistance by the Branch of Coal Resources of the GS to the Energy Minerals Rehabilitation Inventory and Analysis (EMRIA) program administered by the BLM during the period October 1, 1979, through September 30, 1980, includes the following work and study elements:

A. Study of the geology of coal and related rock sequences in the areas selected for studies of reclamation potential. Provide guidance and support for drilling and sampling activities.

B. Select samples for determination of organic composition and major, minor, and trace-element constitution of coals that may be mined in the near future, and, where possible, for determination of the major, minor, and trace-element constitution of the rock sequence that is closely associated with the coals and might be disturbed during recovery of the associated coals.

C. Estimate the quantity of coal resources present in the reclamation study areas according to standardized definitions, criteria, and methods that have been adopted to maintain validity and comparability of estimates.

D. Evaluate the determined geologic and analytical information on the coal and associated rock sequence in the context of defining the particular factors that might affect exploration, development, mining, reclamation, and utilization planning.

E. Prepare reports describing and work and study program conducted in reclamation study areas for inclusion in applicable reports of the EMRIA Reclamation Studies Series.

Reports specifically include quantitative and qualitative assessment of the coal resources based on geologic studies and analytical information, both new and pre-existing. The

format has generally included discussion of the origin and classification of coals; detailed quantitative estimates classified by degree of geologic assurance, thickness and overburden categories, and legal land subdivisions; tabular presentation of standard coal analytical results, major, minor, and trace-element analytical results, and comparisons with other western coals; and discussions of the coal quantity and quality with particular attention to those elements that can affect recovery and utilization.

Other report elements may be included in reports on some reclamation study areas or may be separately published by the GS when desirable or necessary.

The reports will be submitted to BLM or its authorized agent approximately 6 months after submittal of samples to the laboratory.

Any or all of the above listed work and study elements may be conducted in any particular reclamation study area depending on arrangements with other cooperating agencies about work and reporting division and responsibilities. The list above, I.A. through I.E., is not intended to be exclusive of related work or studies for which desirability and/or responsibility may be established during the course of work programs conducted in the reclamation study areas. The work programs to be conducted in specific reclamation study areas by the Branch of Coal Resources are listed in the following state-by-state summaries.

II. Reclamation study areas, northern Alabama.

A. Location:

Ten or more areas in coal fields of northern Alabama.

B. Objectives and Procedures:

Accept approximately 45 samples of coals in FY 80 for determination of organic composition and major, minor, and trace-element constitution.

C. Report Products:

A qualitative coal assessment of the sampled coal beds will be prepared with standard tabulation and comparison with similar coals in the southern Appalachians.

D. Funding:

	Cost Estimates
Salaries (geological, clerical, editorial, etc.)	$1,500
Travel and O/E	--
Analytical costs	--
	$1,500

III. Reclamation study area, Prairie Dog Creek.

A. Location:

Power River Country; all or parts of sections 5, 7, 8, 9, 10, 14, 15, 16, 17, 18, 21, 25, 26, and 31. T. 6 S., R. 41 E.

B. Objectives and Procedures:

Support for drill program was provided to obtain cores of the coal and overlying rocks. Samples of coal and associated rocks have been accepted for determination of organic composition and major, minor, and trace-element constitution.

C. Report Products:

A report on the quantitative and qualitative coal resources will be prepared for inclusion in the EMRIA Reclamation Study Series. The contents of the report would be approximately as outlined in item I.E.

D. Funding:

	Cost Estimates
Salaries (geological, clerical, editorial, etc.)	$2,000
Travel and O/E	--
Analytical costs	--
	$2,000

IV. Reclamation study area, Ojo Encino.

A. Location:

McKinley County; sections 2, 3, 4, 5, N 1/2 7, part of section 9, T. 19 N., R. 5 W.: parts of sections 33 and 34, S 1/2 35, part of section 36, T. 20 N., R. 5 W.

B. Objectives and Procedures:

Geologic guidance and support were provided for the drill program to obtain cores of the coal and associated rocks. A geologic map of the reclamation study area has been prepared and submitted to the principal investigator. Samples have been submitted for analysis.

C. Report Products:

A report on the quantitative and qualitative coal resources will be prepared for inclusion in the EMRIA Reclamation Study Series. The contents of the report would be approximately as outlined in item I.E. The preliminary geologic map has been modified to include information developed as a consequence of the drill program and has been supplied for the principal investigator for inclusion in the Series report.

D. Funding:

	Cost Estimates
Salaries (geological, clerical, editorial, etc.)	$2,000
Travel and O/E	--
Analytical costs	--
	$2,000

V. Reclamation study area, Rattlesnake Butte.

A. Location:

Stark County; all of T. 140 N., R. 98 W., except sections 1, 12, 13, 24, 25, and 36; east 1/2 T. 140 N., R. 99 W.; sections 29, 30, 31, and 32, T. 141 N., R. 97 W.: sections 25, 26, 27, 28, 29, 32, 33, 34, 35, and 36, T. 141 N., R. 98 W.

B. Objectives and Procedures:

Samples of coal and associated rocks have been accepted for determination of organic composition and major, minor, and trace-element constitution.

C. Report Products:

A report on the quantitative and qualitative coal resources of the reclamation study area will be prepared for inclusion in the EMRIA Reclamation Studies Series. The contents of the report will be approximately as outlined in item I.E.

D. Funding:

	Cost Estimates
Salaries (geological, clerical, editorial, etc.)	$2,000
Travel and O/E	--
Analytical costs	--
	$2,000

VI. Reclamation study areas, Arkoma Basin.

A. Location:

Arkoma Basin of central-eastern Oklahoma.

B. Objectives and Procedures:

Accept approximately 30 samples of coals in FY 80 for determination of organic composition and major, minor, and trace-element constitution.

C. Report Products:

A qualitative coal assessment of the sampled coal beds will be prepared with standard tabulation and comparison with the same and other coals in the general area.

D. Funding:

	Cost Estimates
Salaries (geological, clerical, editorial, etc.)	$1,500
Travel and O/E	500
Analytical costs	--
	$2,000

EASTERN AND WESTERN SECTIONS, BRANCH OF COAL RESOURCES

VII. Coordination, supervision, guidance, and support during all phases of the investigations. Includes accessory costs such as travel and other costs necessary for accomplishment of Work Plan objectives in items.

VIII. WORK PLAN TOTAL: $39,500

BRANCH of REGIONAL GEOCHEMISTRY

ANNUAL WORK PLAN

October 1, 1979, through September 30, 1980

The General Agreement between the Bureau of Land Management (BLM) and the Geological Survey, (GS), dated August 15, 1974, is considered an integral part of the Work Plan.

Purpose and Scope of Program

Assistance by the Branch of Regional Geochemistry of the GS to the Energy Minerals Rehabilitation Inventory and Analysis (EMRIA) program administered by BLM includes the following work and study elements:

A. Characterize the chemical and mineralogical composition of the rock materials that are overburden to mineable coal beds in northeastern Oklahoma. Analyses will include total element chemistry as well as chemistry of solution extracts of the rock materials. A report will be submitted to BLM evaluating these chemical and mineralogical data in the context of defining any potential rehabilitation problems.

B. Continued chemical extract work and interpretative analysis on samples collected from the energy study area, Utah. Emphasis will be placed on the chemical characterization of certain geologic units in the context of defining any potential rehabilitation problems. The potential transfer of this information to other areas in the West where coals of Cretaceous age are to be mined will be evaluated.

C. BLM personnel have requested continued consultative guidance for work in the Black Warrior Basin, Alabama.

FUNDING

	Colorado	Montana North Dakota	Oklahoma	Utah	Alabama
Salaries	$ 3,500	$ 8,000	$ 4,000	$2,000	$4,500
Travel and O/E	1,000	2,500	1,000	500	1,000
Chemical Analyses	12,000	42,000	10,000	--	--
Computer	500	1,500	1,000	--	--
Overhead	1,000	3,000	1,000	--	--
	$18,000	$57,000	$17,000	$2,500	$5,500

GRAND TOTAL: $100,000

Bureau of Land Management
Library
Denver Federal Center
Denver, CO 80225